UNIVERSITY OF NATAL

PIETERMARITZBURG
SOUTH AFRICA

WATTLE RESEARCH INSTITUTE

South African Wattle Growers' Union — University of Natal —
Union Department of Forestry

REPORT FOR 1952-1953

(SIXTH YEAR)

OCTOBER, 1953

COMMONWEALTH MYCOLOGICAL INSTITUTE
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COMMITTEE OF CONTROL OF THE INSTITUTE

Appointed by the South African Wattle Growers' Union (3) :

S. Clegg, Esq. (*Chairman*).

R. B. Fyfe, Esq.

D. R. Scott, Esq.

Appointed by the University of Natal (2) :

Professor A. J. W. Bayer, D.Sc. (*Vice-Chairman*).

Principal E. G. Malherbe, M.A., Ph.D., LLD.

Alternate : Professor A. R. Saunders, D.Sc.Agric.

Appointed by the Union Department of Forestry (1) :

C. E. Lack, Esq., B.Sc.

The Director :

Professor H. Shaw, M.Sc.Tech., Ph.D., F.R.I.C.

Honorary Secretary :

P. G. Leeb-du Toit, Esq., B.Com. (Registrar, University of Natal).

STAFF

(SEPTEMBER, 1953)

DIRECTOR :

H. Shaw, M.Sc.Tech., Ph.D.(Manc.), F.R.I.C.

Silviculture :

S. P. Sherry, M.A.(Oxon.), B.Sc.(South Africa).

Technical Assistants :

M. J. Lourens.
I. J. Meiklejohn.
T. B. Oatley (*Appointed January*, 1953).

Genetics and Plant Breeding :

A. A. Moffett, B.Sc.(Birm.), Ph.D.(Lond.).
Miss K. M. Nixon, M.Sc.(Natal).

Technical Assistant :

G. W. Adams.

Chemistry :

W. S. Martin, Ph.D., D.Sc.(Lond.), A.R.C.S., D.I.C., A.R.I.C.
C. G. Gordon-Gray, B.Sc.Hons.(Natal).

Entomology :

L. L. J. Ossowski, M.F., For.Ing., D.Sc.(Poznan).
R. Boyce, B.Sc.Hons.(Durham). (*Appointed July*, 1953).

Technical Assistant :

G. B. Wortmann.

Administration :

Miss E. K. Smith.

Non-European :

Seven.

Field Experiment Station Overseer (S.A.W.G.U.) :

M. A. Stewart.

FOREWORD

Following the period of adjustment to the new administrative year (September to August), the Report returns to normal proportions and annual publication. Progress in the experiments in general has been described to the end of the past growing season and the accounts cover the full year 1st September, 1952, to 31st August, 1953.

Many of the field trials have passed through the early phase of establishment and tending and for some years henceforward will call for much laborious measurement and scoring without commensurate return in clearly-defined results. Nevertheless, there have been some highly interesting developments, more particularly in certain aspects of the siliviculture and plant breeding programmes, but it must be clearly understood that these are interim and tentative results which will not necessarily persist or be fully substantiated through the full cycle.

One of the hazards of field experimentation under local conditions was experienced for the first time in the severe hailstorm, accompanied by abnormally heavy rain, which occurred on the 1st December, 1952. Fortunately the Experimental Farm was little affected, but irreplaceable plant breeding material in the nursery was lost and stocks of insects both in the insectary and in the laboratory were wiped out. There was minor damage to the buildings.

There has been a gratifying response to the appeal to growers to send in to the Entomology Section details of the occurrence of wattle insects and also specimens of any new or unusual insects. It is hoped that this valuable contribution to the work of the institute will be continued and extended.

H. SHAW, *Director.*

October, 1953.

BUILDINGS AND PLANTATIONS

Main Building.

Further renovations and improvements were carried out in 1953. It was again necessary to clean and paint all the outside wood and metal work and it appears that this substantial cost will have to be met in alternate years. The whole outside surface of the building is in need of re-decoration, but as there is no risk here of deterioration of the fabric, this work has been deferred.

Faults in the original design of the entrance to the main garage have been remedied by minor re-construction, with consequent greatly improved access. A relatively inexpensive treatment seems to have removed one cause of water seepage in one room of the building, but the trouble has not been completely eliminated. The treatment against white ants appears to have been at least partially effective and no activity has been noted for several months. A portion of the Library floor where the wood blocks have lifted was examined by an officer of the Bureau of Standards. Excessive moisture was measured in the lifted blocks and evidence of moisture seepage from the ground through a faulty bituminous layer was noted. This, together with the tight laying of the blocks within the concrete surround and with no provision for expansion, was considered to be responsible for the trouble. Arrangements have been made to have part of the floor relaid and to have an expansion strip inserted between the blocks and the surround.

The approaching completion of the Natal Agricultural Research Institute building raises the hope that at long last, it will be possible to put the approaches to the Institute in reasonable order. The existing tracks are in such a state that at times following heavy summer rains, access to the Institute has been possible only with the greatest difficulty. Plans are in hand for laying out the surroundings of the building once the major construction work nearby is finished.

Field Experiment Station.

Over twelve miles of the new road system at Bloemendal, including practically all the more difficult portions, have been completed using only the Ferguson equipment and normal farm labour. The finished roads have stood up extremely well to use and to the weather. The new storage reservoir was completed and there is now, in all, a reserve of some 40,000 gallons of water available for domestic use and nursery irrigation. There was an abundant supply right through the dry autumn and winter.

As foreshadowed a year ago, agricultural crops have been completely eliminated from the farm system and the land vacated is being prepared for planting experimental material in due course. Approximately 120 acres have now been laid down to experiments, details of which are given elsewhere in this Report. The farm has again shown a working profit for the year.

ADMINISTRATION AND FINANCE

The Institute, now entering upon its seventh year, may be considered to have completed its initial development phase and the administration has settled down to a more or less settled routine. In consequence, the work of the Committee of Control has become somewhat lighter and only three meetings were necessary during the year. There has been no change in personnel, but in view of the frequent inability of the Principal of the University, Dr. E. G. Malherbe, to attend meetings, Dr. A. R. Saunders, Director of the Natal Agricultural Research Institute, was appointed alternate representative of the University Council. In March, 1953, Mr. C. E. Lack was nominated to succeed Professor A. J. W. Bayer as assessor member of the South African Wattle Growers' Union Field Experiment Station Committee. It has been decided to appoint annually a Chairman and Vice-Chairman of the Committee of Control and Mr. S. Clegg and Professor A. J. W. Bayer were appointed to these respective offices for the current year.

One of the main items of business before the Committee during the year was the introduction of new salary scales in line with those of the Council for Scientific and Industrial Research and the assimilation of members of staff into these scales. Because of the peculiar relation of the new scales to the old, this was a somewhat involved task and was worked out in detail by a sub-committee whose recommendations were subsequently accepted and implemented by the Committee of Control.

In the course of considering ways and means of furthering certain investigations on wattle wood started by the National Chemical Research Laboratory of the C.S.I.R., the possibility was considered of the latter body's subsidizing those parts of the Institute's work which deal with wattle products as industrial materials. This matter is now the subject of discussion with the Council.

As there was no suitable applicant, no award of the Wattle Research Institute Scholarship was made for 1953.

Expenditure and Income.

The changes in staff salary scales and increments mentioned above led to a substantial increase in expenditure on salaries as compared with the estimates. There was, on the other hand, a considerable saving due to the fact that new posts for which provision was made were not filled. No officer travelled overseas on Institute business during the year so the contingent provision included in each year's estimates against this possibility was not required. In consequence, an appreciable saving in travelling expenses is shown.

The last full year with which to compare the accounts for 1952–3 is the calendar year 1951, before the change to the September–August year. In comparison, expenditure increased by approximately £3,300 of which all but about £600 was due to the increased cost of salaries and allowances. It would appear safe to assume that other costs have now reached a more or less stable level.

Two items of income call for special comment. A donation of £250 was received from the Rhodesian Wattle Company, Limited, in appreciation of help and advice given by the Institute in combating a serious outbreak of chafer beetle. The Institute gratefully acknowledges this gift which, with the concurrence of the donors, was used

to purchase a high-grade camera and other optical equipment, thus making a valuable contribution to the Institute's resources. The income from analytical services is somewhat inflated since it includes a substantially non-recurring amount arising from certified analyses of wattle extract shipments exported on account of the United States Government.

The summarized statement of Expenditure and Income for the period 1st September, 1952, to 31st August, 1953, appears below. Detailed accounts and the Balance Sheet are published separately.

RESEARCH INSTITUTE ACCOUNT

1st September, 1952, to 31st August, 1953

Expenditure	£	s.	d.	*Income*	£	s.	d.
Research and Administrative Staff Salaries, etc.	13,292	16	4	S.A.W.G.U. Grant ..	12,414	8	9
Scholarship	80	0	0	Department of Forestry Grant	5,000	0	0
Travelling and Subsistence	744	14	3	Rhodesian Wattle Company Donation	250	0	0
Laboratory and Office Equipment and Maintenance	2,319	11	9	Analytical Services ..	241	10	0
Library	394	4	9				
Printing and Stationery	245	16	4				
General Administration	623	19	4				
Building Maintenance ..	204	16	0				
	£17,905	18	9		£17,905	18	9

STAFF

Changes in the staff during the year have been fewer than in any similar period since the opening of the Institute. For the first time, a whole year has passed without a single resignation from the European staff, even among the most junior assistants. The position with regard to new appointments is less satisfactory, for the senior post of Plant Physiologist remains vacant and it has not yet been found possible to fill the newly-created post of Assistant Silviculturist.

In July, 1953, Mr. R. Boyce, an honours graduate in zoology of King's College, Newcastle, in the University of Durham, joined the Institute staff as Assistant Entomologist.

Among the Technical Assistant staff, Mr. G. B. Wortmann was promoted to Technical Assistant, Grade III, and Mr. T. B. Oatley was appointed in January, 1953, to a vacant post as Junior Technical Assistant in the Silviculture Section.

The rapid increase in routine analytical work, much of it in connection with investigations in progress in other sections, has placed a heavy burden upon the research staff of the Chemistry Section. In order to relieve the position, authority has been sought and granted for the appointment of a Grade II Technical Assistant competent to take over this work. An incumbent is now being sought for this post.

Miss K. M. Nixon, of the Genetics Section, is to be congratulated upon the conferment of the M.Sc. degree by the University of Natal.

Mr. P. E. Metcalf continued his studies as holder of the Wattle Research Institute Scholarship in the Entomology Section until the 31st January, 1953.

Students from the Department of Zoology were again employed in the Entomology Section for the seasonal bagworm surveys and Mr. R. C. Handley worked in the Silviculture and Entomology Sections during October and November. The Chemistry Section also used temporary assistance for two months to help with routine analytical work.

Mr. S. P. Sherry, Head of the Siliviculture Section, was absent overseas on long leave for four months from April to August, 1953.

ADVISORY WORK, COMMITTEES, CONFERENCES, ETC.

Advisory.

There has been an increase of nearly 50 per cent. in advisory letters written during the year as compared with the previous similar period. Of the total of 290, all but a dozen were replies to queries from Southern Africa. The predominant subjects were again insects and pest control (129) followed by silviculture and allied topics (69). Weed control (11) attracted increased attention and enquiries for publications (20) showed a marked rise. Many more publications were sent out in the course of answering specific enquires. Attention is drawn to the list on page 13 of publications at present available.

Owing to the Silviculturist's absence on leave for part of the year, fewer advisory visits were made by this Section, but the Entomologist made no fewer than 61 such visits widespread over Natal and including also East Griqualand, Pondoland, and Southern Rhodesia. In the absence of the Silviculturist, several estates were visited by the Director and the Entomologist in connection with cases of rapid death in wattles. This trouble is still under investigation. A special field investigation was undertaken by the Geneticist at the request of the Forestry Department. This concerned the botanical identification and the possibilities of hybridization in certain trees alleged to be silver wattle which were being stripped in apparent contravention of the regulations governing the trade in wattle bark. The bark in question was also sampled for chemical analysis.

Visitors to the Institute during the year increased to about 100 and many of these visited the Field Experiment Station also. Among the visitors from overseas were Dr. W. A. Roach of East Malling Research Station, Professor Johanna Westerdijk of Baarn, Holland, and Mr. Gerard d'Erlanger of the Forestal Land, Timber and Railways Co., Ltd., London. In addition, several parties of growers, students, and others have visited the Experiment Station.

The Institute has been consulted and, in some cases, has taken part in discussions on special matters raised by the State Information Office, the South African Scientific Liaison Office in the United States, the Department of Commerce and Industries, the Land and Agricultural Bank, the Natal Provincial Roads Department, the Town and Regional Planning Commission, the Portuguese and the United States Consulates in Durban, the Scientific Council for Africa, and the Colonial Products Advisory Bureau in London, among others. The Institute has also been consulted outside the scope of normal advisory work by commercial firms, some of them overseas, students, and research workers.

In collaboration with the Government Entomologists at Cedara, the Entomology Section of the Institute prepared a questionnaire on behalf of the Wattle Growers' Union on the wattle bagworm situation. The Section subsequently undertook the collation and analysis of the replies and prepared a report thereon. An independent report on the results of the aerial spraying campaign against bagworm in 1952 was also prepared for the Union.

The check analysis of Government Bark Inspector's samples continued on a somewhat increased scale, and the Chemistry Section also analysed and certified under United States Government requirements several consignments of wattle extract.

In co-operation with members of the staff of the Natal Tanning Extract Co., Ltd., the Institute planned and organized the layout of the Wattle Industry Exhibit for the 1953 Royal Agricultural Show in Pietermaritzburg. To avoid the serious diversion of activities of the research workers experienced in previous years, the execution of the display was entrusted to a commercial artist.

Semi-popular articles on the current bagworm situation and on the history of the wattle industry in South Africa were prepared for the local press.

Committees, etc.

The Director attended the Annual Meeting of the Leather Industries Research Institute Research Advisory Council held in Grahamstown in June, 1953, representing on that occasion the South African Wattle Growers' Union as well as the Institute. An informal meeting of the Leather Research Institute Wattle Technical Committee was held at the same time, and the Director and Dr. Martin attended a full meeting of this committee in November, 1952.

The Director attended all the meetings of the General Committee of the Wattle Growers' Union and, along with Mr. Sherry, was a member of the Union's Field Experiment Station Committee and Royal Show Exhibit Committee. He served, along with Dr. Ossowski, on the Union's reconstituted Pest Control Sub-Committee and was also a member of the newly-established Mechanization Committee. It is anticipated that the Institute will be able to assist this last-named committee in the collection and indexing of published literature.

In association with the Wattle Extract Manufacturers' Technical Committee, the Chemistry Section has taken part in collaborative work and discussions on the sampling and analysis of wattle bark and extract.

Conferences, Lectures, Meetings, etc.

The Director and Dr. Martin took part in a round-table informal conference convened by the Forestry Department to enable interested parties to discuss with Dr. Wicht the extension of Hydrological Research in Natal, with special reference to the influence of tree plantations in general and wattle in particular.

Mr. Gordon-Gray presented a paper on analytical problems of black wattle tannin before a symposium on wattle chemistry organized by the South African Chemical Institute. The Director and Dr. Martin also attended and contributed to this meeting.

Dr. Ossowski addressed a meeting of the Board for Agricultural Education in Pondoland East on wattle protection.

From time to time, facilities have been provided at the Institute for the demonstration to growers of various items of equipment. These have been for the most part machines designed for the application of insecticides and herbicides in the form of conventional wet sprays or fogs.

LIBRARY

The flow of new material into the Library continues to increase and during the year, 28 books, including three theses, and 184 bulletins were received, making totals of 205 and 1,285 respectively. Seven new periodicals and one report were added to the list of publications received.

A miscellaneous collection of general forestry publications, reprints, and bulletins taken over from the Wattle Growers' Union has yielded a number of useful items. The Institute has also taken charge of a stock of government wattle publications previously held at Cedara College of Agriculture.

Apart from a few items temporarily held in abeyance, all the arrears of binding have now been completed and as a result, most of the shelf space currently available has been filled. Fortunately there is ample room for expansion for many years to come.

Further names have been added to the permanent mailing list, mostly on request, and the list now includes 117 names in 19 countries.

The following publications, some issued by government departments and some by the Institute, are available and may be obtained on request :

South African Tanning Materials. Part I. The Black Wattle. C. O. Williams (1927).

South African Tanning Materials. Part II. Trees and Plants Other than Black Wattle. C. O. Williams (1930).

South African Tanning Materials. Part III. C. O. Williams (1932).

South African Tanning Materials. Part IV. Bibliography and References. C. O. Williams (1934).

The Wattle Industry in South Africa. I. J. Craib (1935).

Studies on Gustatory Reactions and Feeding of Wattle Bagworm. L. B. Ripley, B. K. Petty and P. W. van Heerden (1936).

Control of the Wattle Bagworm by Dusting with Natural Cryolite. L. B. Ripley *et al.* (1936).

Gradering en Bemarking van Wattelbass (1937).

Grading and Sampling of Wattle Bark. A. J. Taylor (1942).

The Degree of Natural Crossing in Green Wattle and its Bearing on Wattle Breeding. J. Philp and S. P. Sherry (1946).

The Silviculture of Black Wattle. S. P. Sherry (1947).

The Genetics of Hybrids between Green Wattle and Black Wattle. J. Philp and S. P. Sherry (1949).

Wattle Research Institute Report for 1948.

Wattle Research Institute Report for 1949.

Wattle Research Institute Report for 1950.

Wattle Research Institute Report for 1951–1952.

Freedom from Want. W. S. Martin (1949).

Possibilities for Co-ordinated Wattle Research in the African Region. H. Shaw (1949).

Notes on the Chemical Control of the Wattle Bagworm, 1949–1950. L. L. J. Ossowski (1950).

Report on the Possibilities for Wattle Cultivation in Tanganyika and Nyasaland. S. P. Sherry (1950).

The Valuation of Wattle Plantations for Insurance. S. P. Sherry (1950).

Pre-sowing Treatment of Wattle Seed. A. A. Moffett (1952).

Notes on Research and Recommendations in Relation to Wattle Production. (1951).

Natal, Home of the Union Wattle Industry. H. Shaw (1951).

The Wattle Industry in South Africa. H. Shaw (1952).

Differential Germination in the Black Wattle Caused by Seed Treatment. A. A. Moffett (1952).

Notes on Wattle Insects Observed during the Period 1949–1952. L. L. J. Ossowski (1952).

A Comparison of the Droplet Size in Oil Fogs. P. E. Metcalf and L. L. J. Ossowski (1952).

General Environmental Requirements for Commercial Cultivation of Black Wattle in South Africa. S. P. Sherry (1952).

The Establishment and Re-establishment of Wattle Plantations. S. P. Sherry (1952).

A Revised Valuation of Wattle Plantations for Insurance. S. P. Sherry (1952).

ACKNOWLEDGEMENTS

The Institute gratefully acknowledges its indebtedness to the undermentioned for assistance rendered in a variety of ways during 1952–53.

To the Division of Soil Conservation, Pietermaritzburg, for assistance in preparing sun prints.

To South African Pulp and Paper Industries, Limited, for a further gift of used paper-machine wire.

To the South African Bureau of Standards for advice on the treatment of certain minor defects which had developed in the building.

To Dr. R. Melville, of the Royal Botanic Gardens, Kew, for wattle seed collected in Australia.

To Professors A. A. Rayner and A. R. Saunders, of the Faculty of Agriculture in the University of Natal, and to the Statistics Department of Rothamsted Experimental Station for assistance in the analysis of field data.

To the Entomologists of the Commonwealth Institute of Entomology and of the British Museum (Natural History) for assistance in identifying entomological material.

To Sir Guy Marshall for identifying beetles damaging pine seedlings at Weza.

To Mr. E. E. R. Thole for facilities on his farm for carrying out pollen drift studies along the boundary of Bloemendal.

To the many growers who have provided facilities for conducting experiments in their plantations and, in certain cases, have co-operated in making observations and recording results.

To all the growers who have co-operated in reporting the incidence of wattle insects and in sending material for the Institute's insect collection. This help has proved most valuable and it is hoped that it will be continued.

To the management and research officers of the Natal Tanning Extract Company, Limited, for copies of internal reports on matters of interest to the Institute.

PART II. RESEARCH REPORT

PROGRAMME OF EXPERIMENTAL WORK IN PROGRESS AND PROJECTED

ENTOMOLOGY

1. Aerial Spraying Experiment.

An aerial spraying experiment against bagworms will be conducted over an area of approximately 200–300 acres. Two different rates of application of one concentration of insecticide will be used and spraying will be carried out in conjunction with the commercial spraying organized by the South African Wattle Growers' Union.

2. Wattle Bagworm Survey in Thornveld.

A bagworm survey in the thornveld is to be carried out in order to determine whether dangerous breeding centres exist there and whether these insects are still infiltrating cultivated wattles from the thorns. Material collected from thornveld will be kept under observation in the insectary, mainly to determine the species of parasites attacking these bagworms.

REVIEW OF WORK IN PROGRESS

(a) SILVICULTURE

1. Thinning Experiments.

(*a*) Experiment No. S.1 at Broadmoor (Wartburg district) was re-measured in April, 1953. An analysis of the data from this measurement showed that at four years of age, plots at densities of 650 and more trees per acre were significantly (P=0·05) suppressed in relation to plots with densities of 500 and less per acre.

(*b*) Experiment No. S.3 at Bloemendal (Pietermaritzburg district) was thinned and measured in December, 1952, and June, 1953. An analysis of the data showed that at two years of age, there was no significant difference in the growth rate of dominant trees between plots covering the range of densities from 450 to 1,100 trees per acre. At two and a half years, however, dominants in plots at densities greater than 750 trees per acre were significantly suppressed in relation to those in plots at densities below this figure.

(*c*) The growth of natural regeneration in Experiment No. S.5 on the Clan Syndicate Estate (Albert Falls district) proved so irregular that the estate management agreed to clear the ground and replant the area with treated seed. This was done in August, 1952 ; a good even stand resulted and has since been blocked out and singled to 3 feet apart in the rows.

(*d*) Experiment No. S.16 was laid out at Bloemendal in March, 1953, to test the effect of delayed early thinnings on the subsequent growth and final yield of wattle stands. In this experiment, first thinnings will be carried out at various mean heights up to 10 feet.

2. Thinning and Weeding in Relation to Disease Incidence.

(*a*) Experiment No. S.2 at the Umvoti Wattle Company Estate (Kranskop district) received its final thinning and was measured and scored for gummosis in October, 1952, at three years of age. The thinning treatments applied were as follows :

(A) Plots thinned to 540 trees per acre in 2 operations before reaching a mean height of 3 feet and then to 500 trees per acre at a mean height of 35 feet.

(B) Plots thinned in 4 operations, at mean heights of 6 inches, and 5, 15, and 35 feet, to a final density of 500 trees per acre.

(C) Plots thinned in 7 operations, at mean heights of 6 inches and 3, 5, 10, 15, 25, and 35 feet, to a final density of 500 trees per acre.

(D) Plots thinned to a spacing of 18 inches apart in 6 foot rows before reaching a mean height of 3 feet and not thinned again until they reached a mean height of 10 feet. Plots then reduced in 4 additional operations, at mean heights of 10, 15, 25, and 35 feet, to a final density of 500 trees per acre.

These thinning treatments occupied sub-plots in a split-plot layout in which each main plot received one of the following weeding treatments, after a preliminary clean hoeing when the seedlings were about 6 inches high :

(i) No weeding. Wattle regrowth removed by hand-pulling while very small.
(ii) Weeds and wattle regrowth removed by hand-pulling.
(iii) Weeds and wattle regrowth removed by hoeing.

Mean breast height diameters in inches at three years of age are presented below :

Weeding treatment	Thinning treatment				Mean
	A	B	C	D	
No weeding	3·20	3·05	3·37	2·85	3·12
Weeding by hand-pulling	3·32	3·07	3·43	2·90	3·18
Weeding by hoeing	3·13	3·08	3·27	2·88	3·09
Mean	3·22	3·07	3·36	2·88	

	Weeding	*Thinning*	*Interaction*
Standard error	0·025	0·046	0·097
Significant difference (P = 0·05)	0·079	0·130	0·276
Significant difference (P = 0·01)	0·112	0·174	0·369

These data suggest that growth in unweeded plots was slightly superior to that in hoed plots, but inferior to that in hand-pulled plots, though the difference was not significant. The hoed plots, however, had a significantly smaller mean diameter than the hand-pulled plots, and it may, therefore, be assumed that damage to roots caused by the hoeing has been responsible for this reduction in diameter growth.

There were significant differences in diameter growth between all four thinning treatments, the gradual thinning in 7 operations (C treatment) giving the greatest mean diameter, and the D treatment, in which trees were left standing at close intervals in the rows until plots had a mean height of 10 feet, the smallest. The A and B treatments, comprising respectively very heavy early thinnings and relatively heavy thinnings at intervals, were intermediate in their effect on diameter growth, the former being significantly superior to the latter.

The percentages of trees showing symptoms of gummosis were scored concurrently with the above measurement and these data are presented below :

Weeding treatment	Thinning treatment				Mean
	A	B	C	D	
No weeding	21·33	23·47	26·53	20·27	22·90
Weeding by hand-pulling	55·43	60·38	57·42	64·22	59·36
Weeding by hoeing	60·23	59·20	69·03	61·65	62·54
Mean	45·66	47·68	50·99	48·71	

	Weeding	*Thinning*	*Interaction*
Standard error	1·920	2·138	4·534
Significant difference (P = 0·05)	6·050	6·088	12·914
Significant difference (P = 0·01)	8·605	8·131	17·248

There were no significant differences attributable to thinning treatments in the percentage incidence of gummosis, but there was a highly significant (P = 0·01) difference in the percentage of gummosed trees between weeded and unweeded plots, in favour of the latter. An interesting and somewhat unexpected result was the absence of any significant difference in disease incidence between plots which were weeded by hand-pulling and by hoeing.

These results suggest that the percentage incidence of gummosis in wattle plantations may be considerably reduced by weeding only in the early stages, when smal-seedlings are liable to be smothered by dense weed-growth. It would appear also that diameter growth has not been seriously affected by failure to control weed-growth until the stand has closed canopy, but that delaying thinnings in the early stages of growth has affected diameter increment adversely.

(*b*) A second experiment, No. S.9, planned on similar lines to No. S.2, but with some modifications in treatment, was laid down at Bloemendal in January, 1953.

(*c*) Experiment No. S.15 was laid down at Bloemendal in March, 1953, to compare the effect of hand-pulling of weeds and wattle regrowth with that of hoeing upon disease incidence in stands receiving identical thinning treatment.

3. Effect of Season of Green Pruning upon Disease Incidence.

Pruning treatments in Experiment No. S.6 at Bloemendal were begun in March, 1953, and have been repeated at intervals of two months since then, each time on a fresh set of plots. Counts of trees affected by gummosis are being made at intervals and a preliminary evaluation of results should be possible in about one year's time.

4. Row Espacement Experiment.

Experiment No. S.4 at Bloemendal was measured in April, 1953, at the age of 18 months. An analysis of the data revealed that there was no significant difference in either mean breast height diameter or mean tree height in plots established at row espacements of 6, 9, and 12 feet respectively. There was considerable site variation over the area of the experiment, however, and the data indicate that variance due to site was much greater than that due to treatment, so that treatment effects may possibly have been obscured.

5. Long-term Study of the Effects of Brushwood Burning on the Site and on the Crop.

Measurements of run-off and of soil- and litter-loss have been carried out over a twelve months' period in Experiment No. S.7 at Bloemendal. Although the first rains of the season fell in August, 1952, and a total precipitation of 218·6 mm. (8·61 in.) had been recorded up to the end of the first week in December, there were no heavy showers during this period and no run-off took place. The first rain to cause run-off was a thunderstorm on the 9th December, 1952, during which 22 mm. (0·87 in.) of rain fell in approximately half an hour. The soil-loss caused by this rain was approximately fifteen times as great from plots where half the brushpiles had been burnt as from plots where all the brushpiles had been left to rot down naturally, but plots on which all the brushwood was burnt lost more than two hundred times as much soil as the unburnt plots. The greatest soil- and litter-loss occurred on the steepest slope and, in the plot in which all the brushwood was burnt, was equivalent to 0·51 tons of leaf-litter and 8.64 tons of soil per acre.

During the remainder of the rainy season, measurable run-off occurred on seventeen occasions and on nine of these, soil-loss was recorded. The total amount of soil lost on the steeper slopes from plots in which all brushwood was burnt averaged 45·32 tons per acre, or approximately one-third of an inch of top soil, during a period of four months.

6. Influence of Depth of Sowing upon Survival of Seedlings.

An experiment, No. S.13, was carried out at Bloemendal to compare the survival of seedlings from sowings at depths of 1 and 3 inches respectively with that of natural regeneration in seed-beds prepared to depths of 1 and 3 inches. The experiment was begun in February, 1953, and during the period of six months which elapsed between sowing and the counting of surviving seedlings in August, only 172·6 mm. (6·80 in.)

of rain fell. Owing to these dry conditions, seedling mortality was high, and although artificial sowings gave a higher rate of survival than natural regeneration, and survival with deep sowings was higher than with shallow, these differences were not significant.

7. Effect of Nitrogenous Fertilizer upon Seedling Survival near Brushpiles.

It is often found that high seedling mortality in tree rows immediately adjacent to brushpiles makes it difficult to secure adequate stocking in these rows. On the theory that this mortality might be due to nitrogen starvation, it was decided to test the effect upon seedling survival of treating these rows with nitrogenous fertilizer at the time of re-establishment.

An experiment, No. S.14, was laid out at Bloemendal in March, 1953, in which treatments consisted of applications of ammonium sulphate at three levels, namely 0, 100 lb., and 200 lb. per acre along the rows. Half the seedbeds were sown with treated seed and half left to regenerate naturally. Treatments were repeated on opposite sides of the brushpiles which, in this case, ran roughly east and west across a slope with northern aspect. A summary, showing the number of seedlings surviving per 15 foot length of row at six months from sowing, is presented below :

Side of brushpile	Artificial sowing			Natural regeneration			Mean
	O	1N	2N	O	1N	2N	
Upper—South ..	41·7	53·2	32·1	11·9	23·6	14·1	29·4
Lower—North ..	11·6	20·3	14·0	6·2	10·8	7·0	11·7
Mean	26·6	36·8	23·1	9·1	17·2	10·6	

	Side of brushpile	*Treatment*	*Interaction*
Standard error	5·164	4·361	6·167
Significant difference (P = 0·05)	16·84	12·27	17·35
Significant difference (P = 0·01)	24·50	16·27	23·01

Survival rate of seedlings was significantly higher on the upper side of the brushpile, which faced southwards, probably because of higher soil moisture content on this side, and it was also significantly higher in artificial sowings than in natural regeneration. The apparently higher survival rate with applications of ammonium sulphate at a rate equivalent to 100 pounds per acre compared with no fertilizer was not significant. There was, however, a significant difference in survival between seedlings fertilized at a rate of 100 pounds and those fertilized at a rate of 200 pounds per acre, presumably because of injury to seedlings at the higher level of application.

8. Effect of Contour Furrows in Conserving Soil Moisture on Dry Aspects.

Experiment No. S.17 was laid down at Bloemendal in March, 1953, to test the effect of contour furrows, approximately 10 yards apart, in conserving moisture on a dry site with a northern aspect. The existing stand on this site has not yet been felled and it will not be possible to assess the effect of contour furrows upon survival of regeneration until the end of next winter.

9. Time of Onset of Suppression in Relation to Density of Stand.

An experiment, No. S.10, was begun at Bloemendal in January, 1953, with the object of determining the age at which stands, thinned early to densities between 100 and 1,000 trees per acre, cease to be free-growing.

10. Trials of Oil Sprays for Killing Wattle Regeneration.

An experiment, No. S.18, was laid down in a block of jungle wattle at Cedara (Howick district) in February, 1953, in an attempt to find a cheap and effective method of killing off unwanted wattle regeneration.

Treatments consisted in spraying the foliage of the trees, which ranged in height from 3 to 12 feet, with various oils by means of pressure sprayers with fine nozzles. The oils tried were Diesoline, power paraffin, and used sump oil, but the last-named proved too viscous to be sprayed satisfactorily and the experiment was carried out with Diesoline and power paraffin only, at rates of 10, 20, 30, 40, and 50 gallons per acre.

At rates of both 40 and 50 gallons per acre, each oil caused some scorching of foliage and killing back of leading shoots. In no case were trees killed back to more than half their height and even with the heaviest applications, the scorching of the foliage was insufficient to kill trees of this size. It was noteworthy, however, that wherever spray had wetted the stems of the larger trees, the bark at that point turned black and gummosis symptoms appeared. It is possible, therefore, that direct application of either of these oils to the base of the stem may prove a satisfactory method of killing larger trees of undesirable species, such as silver wattle.

(b) GENETICS AND PLANT BREEDING

1. Breeding.

(*a*) *Green wattle* (Acacia decurrens). Of the 23 families of the second inbred generation (S_2) sown in 1951, 8 in which there were sufficient seedlings were included in a trial to compare the S_2 generation with natural (open-pollinated) progeny of the original parent trees. The natural seed was from the same collection as that planted in 1944 at Sweetwaters to compare natural- and self-pollinated (S_1) progeny and may, therefore, be used as a standard of comparison for the S_1 and S_2 generations. For the purpose of this comparison, the Sweetwaters scoring closest in average height to the 1953 scoring was taken. The relative heights are summarized below :

Original tree number	Sown Sweetwaters, 1944			Sown Bloemendal, 1951			
	Open pollination : height in feet	S_1 Generation: height in in feet	% Difference in height	Open pollination : height in feet	S_2 Generation : family number	S_2 Generation : height in feet	% Difference in height
G20	6·88	6·84	0·58	8·38	S12/51	6·28	25·05
G20	—	—	—	—	S14/51	6·01	28·28
G22	6·84	5·79	15·35	7·66	S19/51	6·19	19·19
G26	7·13	6·87	3·65	8·15	S23/51	6·38	21·72
G27	6·85	4·75	30·66	8·57	S24/51	5·28	38·39
G27	—	—	—	—	S25/51	4·62	46·09
G27	—	—	—	—	S28/51	5·47	36·17
G28	5·59	5·25	6·10	7·12	S29/51	6·57	7·72
Mean	6·66	5·90	11·41	7·98		5·85	26·69

In the majority of families, a second generation of selfing produced a further decrease in relative height except, possibly, in the case of S29/51. The immediate parent of S29/51 set considerably more seed than any of the other S_1 trees selfed and there was no segregation for any major recessive genes. The original parent tree, G28, was exceptional amongst those examined in that with open pollination, the tree was selfed to about the same extent as when crossing was prevented by bagging (Philp and Sherry, 1946). The evidence suggested that the tree was largely cross-sterile and, from selfing the S_1 generation, it would seem that some, at least, of the selfed progeny of G28 were more self-fertile than the average. Natural seed from G28 would contain a higher than average proportion of selfed seed, thus reducing the difference between selfed and natural progeny.

(*b*) *Interspecific hybrids.*

(i) *Green and black wattle hybrids* (Acacia decurrens and A. mollissima). It has now been established that hybrids have been produced from the cross-pollinations

made in 1950 and 1951, using black wattle both as seed parent and as pollen parent. In all cases where green wattle was used as seed parent, hybrids were chlorotic to a greater or lesser degree in the early seedling stage. Using black wattle as seed parent, 9 chlorotics occurred out of a total of 45 seedlings. Two of these chorotics died before their nature could be established, while 6 proved to be hybrids. One chlorotic seedling appeared to be non-hybrid while one blue-green seedling was a doubtful hybrid.

Taking all families together, out of 49 blue-green seedlings, 5 died, 43 were non-hybrids, and one a doubtful hybrid, while of 38 chlorotic seedlings, 13 died, 23 were hybrids, and 2 non-hybrids.

Three F_1 hybrid trees at Sweetwaters were back-crossed to green wattle E5, green being the pollen parent. In all three families, there was segregation into blue-greens, yellow-greens, pale yellow-greens, and chimaeras of blue-green and yellow-green or blue-green and pale yellow-green. As the seed parents could not be emasculated, some of these seedlings may be selfs. Taking the three families together, the following were the numbers :

			Chimaeras	
Blue-green	Yellow-green	Pale yellow-green	Blue-green & yellow-green	Blue-green & pale yellow-green
38	26	6	3	59

The same trees back-crossed with black wattle as pollen-parent produced only a very small proportion of yellow-green seedlings and no chimaeras (*Report for 1951–1952*).

The high frequency of chimaeras in back-crosses to green wattle suggests the possibility that their occurence is in some way due to the green wattle parent, a possibility which is further strengthened by the occurrence of chimaeras in a silver wattle x green wattle cross-pollination (See below).

(ii) *Silver wattle* (A. dealbata) x *black wattle and green wattle.* A number of chlorotic seedlings occurred in the progeny of the silver wattle tree S1 pollinated with black wattle B5, but it has not been possible to determine with any degree of certainty whether they are hybrids.

The cross-pollinations silver wattle S2 x black wattle B5 made in 1951 yielded 100 seeds ; 50 of these were sown and 47 germinated.

The seedlings were all uniform in appearance, the first leaf being pale cream with a faint green tinge. Forty-five died between the 20th and 26th days from sowing, without producing second leaves. The remaining two produced minute second leaves and lived for another three weeks, when they were destroyed by hail. This accident apart, their appearance had suggested that their chances of survival were slight.

From the same silver wattle tree, pollinated with green wattle E3, 50 seeds were sown. Of the seedlings, 33 were chlorotics, being yellow-green or pale yellow-green, 15 were chimaeras of blue-green and pale yellow-green, and 2 were not scorable. Although chlorotics in this family were weakly, chlorosis was not lethal in the same way as in the silver x black family. The majority of chlorotics produced several leaves and most of them were alive until damaged by hail six weeks after sowing.

(iii) *Black wattle* x A. baileyana. From the cross-pollination made in 1949, 15 seedlings were raised, of which 3 were black wattle x baileyana hybrids. The hybrids appear to be fairly vigorous and their characteristics intermediate between the parental species. Two black wattle x green wattle hybrids also occurred in the family, due to contamination from nearby green wattle trees. This is readily explained by the fact that when making interspecific pollinations, branches on which bags are damaged are not discarded, since hybrids can be recognized in the progeny. All five hybrid seedlings were chlorotic.

Chlorosis in hybrid seedlings is not confined to green x black hybrids, but would seem to be a usual if not universal concomitant of hybridization in this group of wattles. Further interspecific cross-pollinations have been made in an endeavour to obtain further information on what appears to be a complex situation.

(*c*) *Black wattle.*

Selfed and natural progeny. The selfed and natural (open-pollinated) progeny of black wattle have shown marked differences in vegetative characteristics, height, and basal area of the stems. A number of families segregated for recessive characters which included dwarf habit, reduced leaves, and curled leaves.

In two families, S27/50 and S32/50, there was strong evidence of linkage between pointed pinnules in the seedling leaf and dwarf habit. In S27/50, the single factor ratio of normal to dwarf was somewhat upset by a higher mortality rate in pointed pinnule than normal plants, but there was fairly good agreement with expectation. This family gave a χ^2L value of 56·89 and a crossover value estimated at 8·75 $\pm$ 1·78, the two-factor ratio being :

	++	+ dwarf	pointed +	pointed dwarf
S27/50	96	6	4	21
Expected 9 : 3 : 3 : 1	71·4	23·8	23·8	7·9

In family S32/50 there was a shortage of pointed pinnule recessives which was consistent over all bagged branches (heterogeneity P > 0·99). This shortage was increased by the higher mortality rate in pointed pinnule than in normal plants, which also led to a shortage of dwarfs. The two factor ratio was :

	++	+ dwarf	pointed +	pointed dwarf
S32/50	167	9	1	19
Expected 9 : 3 : 3 : 1	110·2	36·7	36·7	12·2

In family S37/50, there was evidence of linkage between wide spacing of the pinnule on the first seedling leaf and dwarf habit, but the number of plants in the family was small.

Family S31/50 segregated for an unusual dwarf type, the trees having procumbent branches trailing on the ground, reddish bark, and sparse foliage. The procumbent habit behaved as a simple recessive and was apparently lethal, all dwarfs of this type dying when about 18 months old.

The selfed progeny in S38/50 was all like the parent tree in having very small, curly leaves and reduced vigour, but the expression of the character was more extreme ; the heights ranged from 2 feet to 15 feet with an average of 8½ feet. In the open pollinated progeny, there were 55 normal to 8 curly-leaved trees, representing about 69 per cent. cross pollination. Cross-pollinated trees in this family were amongst the most vigorous in the trial.

Stem form and branching habit, both characters of considerable economic importance, showed striking differences between the families, more particularly in S32/50, S33/30, and S34/50.

Trees in S32/50 had wavy main stems and wavy and crooked lateral branches few in number, rather thick, and at right angles to the stem. Stems forked at the top into two or more almost equal branches at a wide angle, giving a broad, flat crown.

In S33/50, main stems were straight and lateral branches rather thin, but very numerous and set at an acute angle to the stem. The upper lateral branches were shorter than the lower, producing a conical type of tree with a narrow pointed crown. Foliage was very dense and the family was the most vigorous in the trial.

In family S34/50, stems were straight and lateral branches fairly numerous, fairly thin, and at acute or right angles to the stem. Towards the top, the stem forked into

two or more almost equal branches at a very acute angle so that the branches grew straight up parallel to each other.

Stem form, branching habit, and density of foliage characteristic of a family were similar in selfed and natural progeny, but in the latter, their expression was not so clear cut, the characters being more dilute.

Height and basal area at 4½ feet were taken as measures of vigour. When families segregated for dwarfs, the recessive types were excluded from the data for both selfed and natural progenies except in the case of S38/50. The parent tree of this family was homozygous for the recessive character reduced curly leaves accompanied by below average vigour.

Differences between selfed and open-pollinated progeny are summarized below :

Family	Height in feet			Basal area in sq. feet		
	Open pollination	Self pollination	% Difference	Open pollination	Self pollination	% Difference
S27/50	24·52	19·21	21·65	0·0540	0·0290	46·30
S28/50	22·27	16·93	23·98	0·0386	0·0206	46·63
S29/50	25·09	20·74	17·34	0·0557	0·0313	43·81
S31/50	23·89	15·58	34·78	0·0545	0·0226	58·53
S32/50	22·95	19·53	14·90	0·0556	0·0367	33·99
S33/50	25·92	19·06	26·47	0·0735	0·0404	45·03
S34/50	23·96	20·04	16·36	0·0548	0·0333	39·23
S38/50	23·15	8·57	62·98	0·0587	0·0085	85·52
Mean	23·97	17·46	27·31	0·0557	0·0278	49·88

Five other families, not included in the statistical analysis because of the low number of individuals in each family, behaved in a similar manner. Family S38/50 is somewhat anomalous and the probability is that the parent tree was itself a selfed seedling. If this were the case, the selfed progeny in S38/50 would be the second inbred generation, which would account for the very high difference between selfed and natural progeny. When the recessives were excluded from the data for natural seedlings, the mean height and basal area were 24·95 feet and 0·0685 sq. feet respectively.

Twelve more selfed families from trees at Bloemendal were sown in September, 1952. A number of these families segregated for recessive factors not previously recorded.

2. Colchicine Treatment.

The progeny of a number of tetraploid trees has now been planted at Bloemendal, but the characteristics have not been scored. Families from a number of tetraploids have also been grown in pots to determine the chromosome numbers in seedlings from tetraploid trees growing in proximity to diploids. It has been established that triploids or approximate triploids occur, but it is not known yet with what frequency.

3. Progeny Testing of Parent Trees.

The first progeny trial at Bloemendal (planted 1950) was scored during June, 1953, for height (3rd scoring), diameter, branching, and foliage. Bark samples were taken from three blocks for tannin analysis.

Differences in height were significant, but the families came closer to the general average than in the previous scoring. The mean height for all families was 26·2 feet, the tallest being 27·6 feet, or 5·5 per cent. above the average, and the shortest 24·0 feet, or 8·5 per cent. below average.

Forking from the base to produce more than one stem was common and there appeared to be family differences in this respect. Analysis showed that these differences were significant (P = 0·01), forking evidently being an inherited character. In this particular trial, the frequency of forking may have been increased by planting from pots.

Since a considerable proportion of the trees had more than one stem, diameter could not be used as a measure for comparison. Instead, basal area (at 4½ feet) was computed and when more than one stem per tree occurred, basal areas were added together.

Differences between families were highly significant and the range of variation greater than for height. The largest mean basal area was 27·6 per cent. above average and the smallest 17·2 per cent. below average.

In the blocks sampled for tannin analysis, two trees out of a possible 16 were taken at random in each plot, making a total of 150 trees. Bark samples in the form of discs of 0·4 inch diameter were taken with a No. 6 cork-borer, at intervals of 1 foot up to a height of 12 feet. Tannin content was estimated by a quick method which gave the relative, but not the true tannin content of the samples (Gordon-Gray, 1953).

No significant differences in tannin content were found between families, but there was a correlation between tannin content and diameter (r = 0·326, d.f. 148) and tannin content and bark thickness (r = 0·304, d.f. 148). There was no correlation between tannin content and height of trees.

Trees sampled were taken at random, only obviously diseased or damaged trees being excluded. The resultant samples contained a wide range of diameters and, in view of the possibility of diameter affecting tannin content, it may be necessary to restrict randomization in order to show possible differences between families.

4. Frost Tolerance.

A trial including five species of wattles frosted in June, 1952, when about one foot high, showed considerable differences in the degree of damage between species. None of the plants was killed, damage only to the leaves occurring. Taking all degrees of damage, the following was the percentage of plants frosted in each species :

Acacia baileyana	0·0	*A. dealbata*	36·0
A. decurrens	87·1	*A. pauciglandulosa*	65·8
A. mollissima	71·9		

A. baileyana would seem to be the most likely source of frost tolerance for breeding, more particularly as F_1 hybrids have already been produced under controlled conditions.

5. Pollen Dispersion.

A second experiment to test the degree and distance to which black wattle pollen is wind borne was carried out at Bloemendal. Open fields bordering on the eastern edge of a plantation were selected as a site having only one source of pollen and little likelihood of lateral contamination. One line of slides extending 800 yards was placed in an approximately central position and at right angles to the plantation, *i.e.*, running in an easterly direction. A second line of slides, starting from the same point as the first, extended 600 yards in a southeasterly direction, *i.e.*, at an angle of 45° to the plantation edge. In both cases, slides were positioned at 100-yard intervals. There were four slides in each position, facing North, East, South, and West in the first line and North-East, South-East, South-West, and North-West in the second. Slides were coated with glycerine jelly and on each slide, two ¾-inch square areas, in which the pollinia were counted, were marked.

The wind during the flowering season persistently came from an easterly direction (blowing towards the plantation) resulting in a low number of pollinia per slide. Over

a 24 hour exposure with a wind force estimated at Beaufort Scale 2–3, slides facing South and West in the first line had a significantly higher catch of pollinia than those facing North and East, the numbers being 22, 19, 7, and 12 respectively. There was no difference in the catch at different positions.

In the second line of slides, those facing South-East and South-West had a higher catch than those facing North-East and North-West. Again there was no difference between the positions.

These results are similar to those of the previous season.

REFERENCES

Gordon-Gray, C. G. (1953) A rapid method of determining the relative tannin content of young, living black wattle trees in genetical and breeding experiments. *Rep. Wattle Res. Inst. for 1952–1953* (1953), 42–48.

Philp, J. and Sherry, S. P. (1946). The degree of natural crossing in green wattle, *Acacia decurrens* Willd. and its bearing on wattle breeding. *J.S.Afr.For.Ass.*, **14**, 1–28.

Philp, J. and Sherry, S. P. (1949). The genetics of hybrids between green wattle (*Acacia decurrens*) and black wattle (*Acacia mollissima*). *J.S.Afr.For.Ass.*, **17**, 1–53.

(c) CHEMISTRY

1. Fertilizer Experiments.

Three experiments have been laid out on different soil types to obtain information on the effects of nitrogen, phosphorus, potassium, and calcium on the growth of wattle. Each treatment was applied at three levels in a quasi Latin square design due to Yates (1937). The results, calculated in height measurements, are summarized below. In the following table, the response to the double dressing is compared with the nil dressing.

MEAN HEIGHT IN RELATION TO TREATMENT

(No treatment = 100)

	1950	1951	1952
Honey Grove—Table Mountain Sandstone.			
Nitrogen, 2 cwt. per acre ammonium sulphate	100	100	100
Phosphorus, 4 cwt. per acre superphosphate	119*	121*	121*
Potash, 2 cwt. per acre muriate	108*	101	102
Lime, 5 tons per acre carbonate	97	101	103
Bloemendal—Shale.			
Nitrogen, 2 cwt. per acre ammonium sulphate		103	102
Phosphorus, 4 cwt. per acre superphosphate		110*	109*
Potash, 2 cwt. per acre muriate		99	104*
Lime, 5 tons per acre carbonate		90*	100
Clan Syndicate—Dolerite.			
Nitrogen, 2 cwt. per acre ammoniun sulphate		100	99
Phosphorus, 4 cwt. per acre superphosphate		107*	107*
Potash, 2 cwt. per acre muriate		99	99
Lime, 5 tons per acre carbonate		104*	103

*Differences significant (P = 0·05)

It will be seen that nitrogen has had no significant effect on any site. Phosphorus as superphosphate has given significant differences on all sites, but the benefit is twice as great on sandy soil as on shale or dolerite. Potassium showed a significant increase

on sandy soil at the first measurement, but the benefit has not been maintained. On the shale, however, the position is reversed, as the trees have improved in this treatment during the second year. On dolerite, potassium has had no beneficial effect.

On sandy soil, lime has had no significant effect, but there is a tendency for limed plots to improve growth with time. On shale, after a significant depression of 10 per cent. in the first year, the trees have shown improvement. On dolerite, the application of lime showed a significant improvement in the first year, but this may be a secondary effect due to the preference of froghopper for unlimed plots early in their first season. Lime, at the rate of 2½ tons per acre, was applied in March to 27 plots, another 27 plots received lime at double that rate, and 27 received no lime. In July, before the application of the NPK treatments, it was seen that the limed plots appeared to be less severely damaged by froghopper than those unlimed. Actual counts of damaged trees were :

Unlimed, 146 ; Lime 2½ tons per acre, 41 ; Lime 5 tons per acre, 36

In this experiment, the lime tended to cake and remain on the soil surface, with the result that there was a much higher light intensity in these plots, which might affect the insect. On the other hand, there is the possibility that cell sap in limed trees was distasteful to the insect owing to extra calcium. An experiment has been laid out on Bloemendal to obtain further information on these points.

Experiments designed to compare different phosphate fertilizers have so far shown that superphosphate and the standard super-raw phosphate mixture are better than ground raw phosphate or calcium metaphosphate.

2. Gummosis.

After a period of very heavy rain during last season, there was a great increase in the number of trees affected by gummosis in various parts of the wattle area. In our experimental areas, incidence of this disease appeared to be worse on fertilized plots than on surrounding trees. Counts of affected trees were, therefore, carried out in a number of fertilizer experiments, but no significant differences were obtained except on one major experiment where plots receiving superphosphate gave higher counts than any other treatment. Plots in an adjoining phosphate experiment on the same estate, however, showed less gummosis than those on the same treatment of the major experiment.

The results, therefore, are not conclusive, but it was noticed on all experiments that the large, well-grown trees seemed to be more susceptible than others. These observations will be continued if suitable climatic conditions develop.

3. Soil Analysis.

Work has been confined to the examination of soils in experimental areas.

4. Bark Analysis.

Work done during the past year includes the routine analysis of about 350 bark samples by the Official Method. Seventy-three barks submitted by the Government Inspector of Wattle Bark were also analysed. The agreement between his visual estimation of tannin content and the analytical results was reasonable.

A method of sampling and analysis, whereby the relative tannin contents of bark of three-year old trees could be estimated without damaging the trees, was worked out for the Genetics Section. Details are given elsewhere in this Report (Gordon-Gray, 1953*a*).

Co-operative work with the Permanent Technical Committee of the South African Wattle Extract Manufacturers' Association was continued. A paper describing this work was read at the July Meeting of the South African Chemical Institute in Durban (Gordon-Gray, 1953*b*).

Mention has been made in previous Reports of the long time required to determine tannin in barks by the Official International Method, and Roux (1951), in an attempt to reduce this time, developed a method of estimating tannin by use of a spectrophotometer. In order to obtain data on the agreement between the results, this method is now being used in the Institute in parallel with analyses of the same materials by the Official Method. It should be noted, however, that even if the spectrophotometric method proves to be satisfactory, it eliminates only the hide powder part of the determination ; the time-consuming extraction of the tannin from the bark remains. Work on extraction is in progress, therefore, to try to find a process in which all the tannin is extracted in a much shorter time. The ultimate test of any such method is, of course, that the results should be reproducible and should agree with values obtained by the Official Method.

REFERENCES

Gordon-Gray, C. G. (1953*a*). A rapid method of determining the relative tannin content of young living black wattle trees in genetical and breeding experiments. *Rep. Wattle Res. Inst. for 1952–1953* (1953), 42.

Gordon-Gray, C. G. (1953*b*). Black wattle tannin—analytical problems and difficulties. *S.Afr. Industr. Chem.* (in the press).

Roux, D. G. (1951). Photometric methods of tannin analysis for black wattle tannin. *J.Soc. Leather Trades' Chem.*, **35**, 322.

Yates, F. (1937). The design and analysis of factorial experiments. *Tech.Commun. Bur.Soil. Sci., Harpenden*, No. **35**, p. 48.

(d) ENTOMOLOGY

1. Bionomy of Wattle Bagworm.

(*a*) *Biotic potential.* Data for the determination of sex ratio and factor were obtained from 12,654 bagworms, and of the average number of eggs, from 33 females. It was found that the sex ratio was 1 female to 1·5 males and the sex factor 0·40. The number of eggs per female averaged 1,102. The annual biotic potential was 440, while the biotic balance amounted to 99·77 per cent.

The annual biotic potential is calculated from the Thompson-Chapman formula and the biotic balance is derived from Bremer's formula, as modified by Zwölfer. Full details of these formulae were given on page 27 of the Institute's Report for 1951–52.

(*b*) *Distribution and density of bagworm population in wattle trees and natural mortality at different heights.* The greatest density and the largest number of bagworms in all height classes in dominant, co-dominant, and intermediate trees were found on the top of the trees. The natural mortality of bagworms in their fifth instar and in the prepupal stage was fairly evenly distributed through all sections of trees up to 24 feet high. In taller trees, the mortality increased in higher sections. In the lower parts of the trees, the mortality was due entirely to *Isaria*, while bagworms killed by polyhedrosis were found mostly on the tops except in trees up to 42 feet high, where polyhedral wilt was found mainly in the middle section. These observations are based on the examination of 35,282 dissected bagworms collected from 169 trees in 20 different plantations.

(*c*) *Population study.* The detailed population study was continued in seven plantations over an area of 400 acres.

2. Development of Starving Bagworms.

Bagworms in their fifth and sixth instars were taken from completely defoliated wattles and pines (*Pinus patula*) and placed in the insectary. They are being periodically examined until late spring to see whether bagworms left without adequate and suitable food will develop into adults able to reproduce.

3. Effect of Bagworm Attack on Increment.

The increment plots at Umvoti, Mowbray, and Spring Grove were checked and sprayed in December, 1952, and again examined and measured in co-operation with the Silviculture Section in July, 1953. Thirty new plots were laid out, ten each in Baviaanskrantz, Spring Grove, and Ihluku (Block 38). The plots in the last-named place were thinned and measured. The increment plots at Highlands and Ihluku (Block 19) had to be abandoned due to absence of bagworms.

4. Parasites and Predators of Bagworms and other Wattle Insects.

Eighteen parasites and predators so far not recorded by this Institute were found on the following wattle insects : *Acanthopsyche junodi* Heyl., *Pachypasa truncata* Wlk., *Achaea lienardi* Boisd., and *Eulepida mashona* Arrow. Further details of the predaceous insects are given elsewhere in this Report (Ossowski, 1953).

5. Chemical Control.

(*a*) *Insecticidal fog treatment.* Two experiments were carried out in the New Hanover and Hilton Road districts with ten per cent. Toxaphene and four per cent. *gamma*-BHC and also for the first time with one per cent. Aldrin and one per cent. Dieldrin, each insecticide in solution in the mineral oil Diesoline. The insecticide was applied by means of the " Kyoritu " fog generator at a rate of two gallons per acre in plantations with trees 30 feet high and of four gallons per acre in plantations 45 to 50 feet high. Weather conditions were not very favourable during both experiments. A strong wind rose approximately two hours after the commencement of each, but in spite of this, the mortality obtained with Toxaphene and BHC ranged from 30·4 to 93·0 per cent. The mortality due to Aldrin, however, was low, amounting to 11·5 per cent. in the plantation with smaller trees and 18·2 per cent. in that with larger trees, while Dieldrin gave kills of 42·2 and 43·0 per cent. respectively.

(*b*) The experiment started in 1950 to determine whether fogging during the copulation and pre-hatching period can stop or reduce hatching was continued and sample plots at Mountain Home were treated at the end of August and beginning of September, 1952. Ten per cent. Toxaphene in Diesoline was used in some plots and four per cent. *gamma*-BHC in others. The silk from the inner bags was examined by the Chemistry Section to determine the labile chlorine content. The following table shows the results :

Insecticide	Date of		No. of females collected	Dead or dying %	Mg. Cl. per g. silk with females	
	treatment	collection			healthy	dead or dying
10% Toxaphene ..	30.viii.52	2.ix.52	56	44·6	Nil	6·74
,,	,,	,,	56	33·9	Nil	7·51
,,	,,	,,	39	38·5	0·79	11·70
,,	,,	,,	68	29·4	Nil	4·65
,,	,,	,,	69	34·8	Nil	7·37
4% *gamma*-BHC ..	6.ix.52	9.ix.52	38	36·8	Nil	2·21
,,	,,	,,	43	65·1	0·82	1·96
,,	,,	,,	42	50·0	Nil	2·74
,,	,,	,,	47	40·4	Trace	1·96
,,	,,	,,	85	52·9	Nil	2·01
,,	,,	,,	32	43·7	0·07	2·20
,,	,,	,,	45	48·9	0·46	2·60
,,	,,	,,	40	50·0	Nil	1·82
,,	,,	,,	58	55·9	0·06	1·21
Control		9.ix.52	150	0·0	Nil–trace	— —

The results are similar to those obtained in 1950 and 1951. There was practically no penetration of insecticide into the bags where the females remained healthy, but determinable quantities were found wherever there were dead or dying insects.

(*c*) *Use of repellents and deodorants.* The exploratory experiments conducted in previous years on a small scale, and so far not fully reported, were extended. Unfertilized females on trees were sprayed with fifteen different chemicals reputed to have repellent or deodorant properties, placed in a plantation for four weeks during the copulation period, and then taken to the laboratory for observation. After the first signs of hatching of bagworm material collected in control plots, the sprayed females will be examined to determine whether they have been fertilized, died without producing a progeny, or left the bag.

6. Identification of Other Insects.

Insects damaging young wattles in Zululand were identified as *Monolepta allardi* Wse.

Insects attacking tung trees in Swaziland were identified as *Sthenias cylindrator* F., and those damaging *Pinus patula* seedlings in Weza plantations were identified by Sir Guy Marshall as *Holcolaccus viridulus sp. n.*

7. Chafer Beetles.

(*a*) The second campaign against adults of *Eulepida mashona* Arrow, prepared in general outline by the Entomology Section, was carried out by the Research and Field Staff of the Rhodesian Wattle Company, Ltd. It started in October, 1952, and approximately 3,000 acres stocked with indigenous bush were treated with ten per cent. Toxaphene or four per cent. *gamma*-BHC, each in solution in Diesoline. A small quantity of 0·5 and one per cent. Dieldrin, also dissolved in Diesoline, was used for experimental purposes over an area of 225 acres. In addition to the machines employed for the application of insecticides during the previous campaign, one "Swingfog" unit was also used. The rate of application was 1½–2 gallons per acre, depending on the stocking of the treated areas.

The final assessment and the analysis of the mortality data was carried out by the Estates Research Officer of the above-mentioned Company. Though it appeared that the population of adults was lower than in 1951–52, the mortality obtained was somewhat higher than during the previous campaign. This was most probably due to the greater experience of the operators applying the insecticide. The average mortality per set of three 6 foot x 6 foot plots per day was 1·56 adults in areas where Toxaphene was used, 2·71 adults in plantations treated with BHC, and 0·01 and 0·04 adults in plots fogged with 0·5 and 1 per cent. Dieldrin respectively. These mortality figures can not, however, be compared with each other, since the insecticides were applied at different times of the season, *viz.*, Toxaphene at the beginning and during the middle of the campaign, BHC towards the end, and Dieldrin at the very end of the campaign, when the beetle population was very much on the decline. It was proved, however, that BHC acted more quickly than Toxaphene, but the latter had a longer residual effect and greater ultimate toxicity.

(*b*) The results of the Toxaphene soil insecticide experiment laid out at Silverstream Estate, Southern Rhodesia, were assessed and analysed. In that experiment, ten per cent. Toxaphene soil insecticide was applied at a rate of 25 and 50 lb. per acre respectively, either in strips or broadcast and hoed in. All treated plots were significantly better than the untreated ones, but none of the treatments differed significantly from any other. The general observation was that there was not a sufficient population of larvae in the plots to afford a fair test on the protective value of the insecticide.

8. Records of Insect Outbreaks.

Records were started for wattle insect pests observed and reported. They include dates of outbreaks and their intensity, acreages infested, parasites, predators, fungus

and virus diseases observed, and other important details. At present, the records contain data concerning 31 species on 108 farms and plantations.

9. Wattle Insect Collection.

A collection of wattle insects was started and at present contains 122 specimens within 40 species.

10. Miscellaneous Insects not associated with Wattle.

Lyctus Powder Post Beetles. The timber stacks at Broadmoor treated in May, 1952, were fogged again in November. Results could not, however, be assessed, due to lack of sufficient material necessary for examination.

Another experiment on the same lines was therefore laid out in Cramond in May, 1953, and treated for the first time in June, 1953. The second treatment will be carried out in September/October, 1953.

11. Insectivorous Birds.

Several birds were found destroying bagworms, wattle noctuids, wattle webworms, and small wattle chafer beetles. Further details are to be found elsewhere in this Report (Ossowski, 1953).

12. Insectary and Cage Breeding.

Specimens of wattle fauna have been kept under observation in the insectary. Portable field insectaries were erected at Bloemendal and in the nursery for the study of the bionomy of some lesser known wattle insects.

REFERENCE

Ossowski, L. L. J. (1953). Notes on insects observed during the period 1952–1953. *Rep. Wattle Res. Inst. for 1952–1953* (1953), 49.

(e) MISCELLANEOUS

1. Weed Control by Chemical Means.

The trial started in February, 1952, in which several esters of 2:4:5-T and similar compounds were applied to American bramble (*Rubus sp.*), gave some very promising results. Except for the butyl ester of 4-chloro-2-methylphenoxyacetic acid, which had very little effect at any stage, all the preparations killed back practically all the mature cane. One year after spraying, however, there were marked differences in the amount of regrowth. One of the three plots treated with the triethanolamine salt of 2:4:5-T was entirely free of living cane, old or new, while the two other replicates each had only one or two shoots of regrowth. The butyl and butoxyethyl esters checked, but did not entirely control regrowth. Further observations will be made on these plots without further treatment.

Another trial to make a closer comparison of a wider range of 2:4:5-T esters and salts was laid down in March, 1953, but not even a preliminary assessment of results can yet be made.

Experience gained in these trials suggests that no reliable indication of the ultimate effectiveness of sprays against bramble can be obtained in less than a year after application. Final assessment should be left until the second growing season following spraying is well-advanced.

A trial of diesel oil, 2:4-D, and 2:4:5-T against aspen (*Populus tremula*) encroaching on grassland was started in August, 1953.

2. Collaboration with other Organizations.

(*a*) *Studies on the tannins of wattle species.* Samples of black and green wattle bark have again been collected by the Silviculture Section for the Leather Industries Research Institute. The investigations during the past year have been mainly concerned with determination of molecular weight of the tannins.

(*b*) *Chemistry of wattle wood, etc.* There have been further discussions with the National Chemical Research Laboratory on these investigations, but during the year, the work was temporarily suspended. Exploration of possible ways and means of restarting it is at present in progress.

(*c*) *Wattle wood as a source of pulp.* A report, together with samples, on the production in Germany of paper from wattle wood by a new process suggests definite commercial possibilities. Further information is being sought.

(*d*) *Rapid death of wattle trees.* Field investigations were made by the Institute staff of several cases of rapid dying among wattle trees. The material collected was taken over for detailed examination by the Plant Pathology Department of the Natal Agricultural Research Institute. Several fungi have been isolated and at present await identification. The investigation is still in progress.

PROGRESS REPORTS AND PAPERS

THE EFFECT OF DIFFERENT METHODS OF BRUSHWOOD DISPOSAL UPON SITE CONDITIONS IN WATTLE PLANTATIONS. I. EXPERIMENTAL LAYOUT AND APPARATUS DESIGNED FOR THE MEASUREMENT OF RUN-OFF AND SOIL-LOSS

By S. P. SHERRY

Uniform sites, each having a different angle of slope, were selected in a wattle plantation, and three methods of brushwood disposal were carried out in adjacent plots on each site after clear-felling. These treatments consisted respectively of burning all the brushpiles, burning alternate brushpiles, and allowing all brushpiles to rot down naturally. Within each of the plots, which were to be used for the measurement of yield and were 0·1 acre in area, smaller plots of 0·01 acre were laid out for the measurement of run-off and soil-loss. These were enclosed by sheet metal, so that run-off from without was excluded and only that resulting from precipitation on the enclosed area was diverted into tanks placed below each plot. The construction of these tanks, which were designed for the collection and measurement of run-off and of litter- and soil-wash from the plots, is described in detail.

When a mature wattle plantation is clear-felled in harvesting the bark, a considerable quantity of brushwood in the form of branches and tops of felled trees is left on the ground. It is essential to dispose of this mass of material in a manner which will avoid interference with the regeneration of the plantation, but the best method of achieving this has been the subject of controversy among growers for a number of years.

In the early years of commercial wattle growing in Natal, some growers disposed of their brushwood by burning the branches and tops where they lay scattered over the plantation floor after the bark and timber had been removed (Sim, 1904). This practice of broadcast burning was abandoned because germination, stimulated by heat, was so profuse that lining-out and thinning became difficult and expensive operations. Instead, the brushwood was stacked in continuous, narrow, parallel piles, at varying distances apart, and burnt when dry enough (Sim, 1917). Even at this early date, a few growers had given up burning brushwood in their plantations and left the piles to rot down naturally, in the belief that the addition of so large a quantity of organic matter to the soil would increase its fertility and improve its physical condition.

When, however, the Union Department of Forestry appointed an officer in 1928 to conduct full-time research on wattle silviculture, most growers were still burning all brushwood after clear-felling. As a result of his investigations, burning was strongly condemned and the stacking of piles of brushwood at regular intervals on the contour as an anti-erosion measure was recommended (Craib, 1934, 1935). Since that time, many growers have given up burning brushwood on the ground that this practice would lead eventually to site deterioration. Some growers, however, have continued to dispose of some or all of their brushwood by burning, and maintain that the practice has no harmful effect upon the site. Unfortunately, no sound, quantitative data in support of either case have yet been brought forward and, therefore, no satisfactory conclusion can be reached regarding the merits of the two systems of brushwood disposal, insofar as their effects on site quality are concerned.

Of all the factors which are known to cause site deterioration, the loss of surface soil by erosion is probably one of the most rapid and direct in action. Wattle sites, unlike most forest sites, are peculiarly susceptible to soil erosion. Plantations are clear-felled during the rainy season in most parts of the wattle-growing area, and many are situated in broken country, where sites are frequently sloping, sometimes very steeply. Thus the soil is exposed by the removal of the tree cover just at the season in which heavy storms occur, and any consequent soil movement is accelerated according to the degree of steepness of the site concerned.

It was felt that comparative data on the effect of different systems of brushwood disposal upon the site could most readily be obtained by measurement of run-off and soil-loss from areas on which these systems had been put into practice. The experiment described in this paper was planned, therefore, with the object of securing such data.

Experimental Method.

In order to obtain quantitative information on run-off and soil-loss, plots of known area were enclosed in such a way that run-off water resulting exclusively from precipitation upon this area could be collected and measured, together with any soil and litter washed down. Each enclosed run-off plot was part of a larger plot in which one of three typical commercial methods of brushwood disposal had been carried out. Since the rate of run-off and soil-loss are influenced by steepness of slope, the treatments were repeated on slopes of varying degrees of steepness.

The run-off plots, 0·01 acre in area, were made as long as possible in the direction of slope, because the momentum gained by unimpeded run-off water is an important factor in determining the rate of erosion. Run-off water and transported soil and litter were collected for measurement in covered tanks constructed below each enclosed plot.

The large outer plots received identical thinning treatments and their yields of bark and timber are to be measured at the end of each rotation. The treatments described below will be repeated on the same plots over a number of successive rotations, so that the cumulative effect, if any, of treatment upon yield capacity can be determined.

Choice of Treatments.

Current methods of brushwood disposal involving the use of fire vary considerably in degree. At one extreme, the brushwood is stacked in continuous parallel piles, twelve feet apart, and burnt, with the result that the leaf litter on the intervening strips is also partly or wholly consumed by the flames from the burning brushwood. Under less drastic treatments, the brushpiles are stacked further apart, and when they are burnt, the amount of leaf litter destroyed decreases as the distance between piles increases. At the other extreme, the brushwood is stacked in continuous piles on the contour, at intervals usually of about thirty yards, and alternate piles are burnt, the remaining piles being left to rot down naturally. The amount of organic matter consumed by fire under any of these systems also varies according to the weather conditions immediately preceding and at the time of the burn. Thus, when burning is carried out on a windy day after a long period of dry weather, the brushpiles are reduced to ash and much of the leaf litter on the soil surface between the brushpiles is also destroyed. On the other hand, if burning is carried out on a calm day, as soon as possible after a soaking rain, many of the thicker branches are merely charred, and the leaf litter is destroyed only in the immediate vicinity of the burnt piles.

In order to cover as wide a range of treatment as possible, the two extreme treatments described above were included, together with a third treatment in which all the brushwood was left unburnt and allowed to rot down. In detail, the treatments adopted were as follows:

(*a*) Brushwood stacked in five parallel piles twelve feet wide and twelve feet apart, at right angles to the direction of slope, and all burnt as soon as possible after rain.

(*b*) Brushwood stacked in two parallel piles, twelve feet wide and thirty yards apart, at right angles to the direction of slope, and the upper pile burnt as soon as possible after rain.

(*c*) Brushwood stacked in two parallel piles, twelve feet wide and thirty yards apart, at right angles to the direction of slope, and left unburnt.

Selection of Site.

A number of factors had to be taken into account in selecting a site for the experiment.

Firstly, it was necessary that the three run-off plots in any one set of treatments have identical angles of slope and comparable slope profiles, and that surrounding yield plots should also be as comparable as possible in slope. It was required, therefore, to find a site comprising several fairly large areas, each of uniform slope.

Secondly, the soil over the area selected had to be of one type and as uniform as possible in composition and depth. In addition, the soil type should preferably be one commonly encountered in wattle growing areas.

Thirdly, it was desirable that the existing stand of wattle on the site selected should be as uniform as possible. The degree of stand uniformity would indicate the degree of site uniformity and the more uniform the site at the outset, the more readily would subsequent changes in site quality due to treatment be detected.

A site was found at Bloemendal, the Wattle Research Institute Field Experiment Station, which satisfied the last requirement listed above. The plantation growing on this site was about eight years old, and measurement of sample plots over that portion of the stand which seemed likely to be suitable for this experiment showed fair uniformity of growth and indicated that site quality was reasonably uniform over this area.

The site was then surveyed and found to contain five adjacent areas, each of which was fairly uniform in slope. Lines were marked out at right angles to the general direction of slope on each of these areas and angles of slope, to points 40 yards distant, downhill, were measured at intervals of one yard along each of these lines. These measurements showed the following range in angles of slope over the five areas :

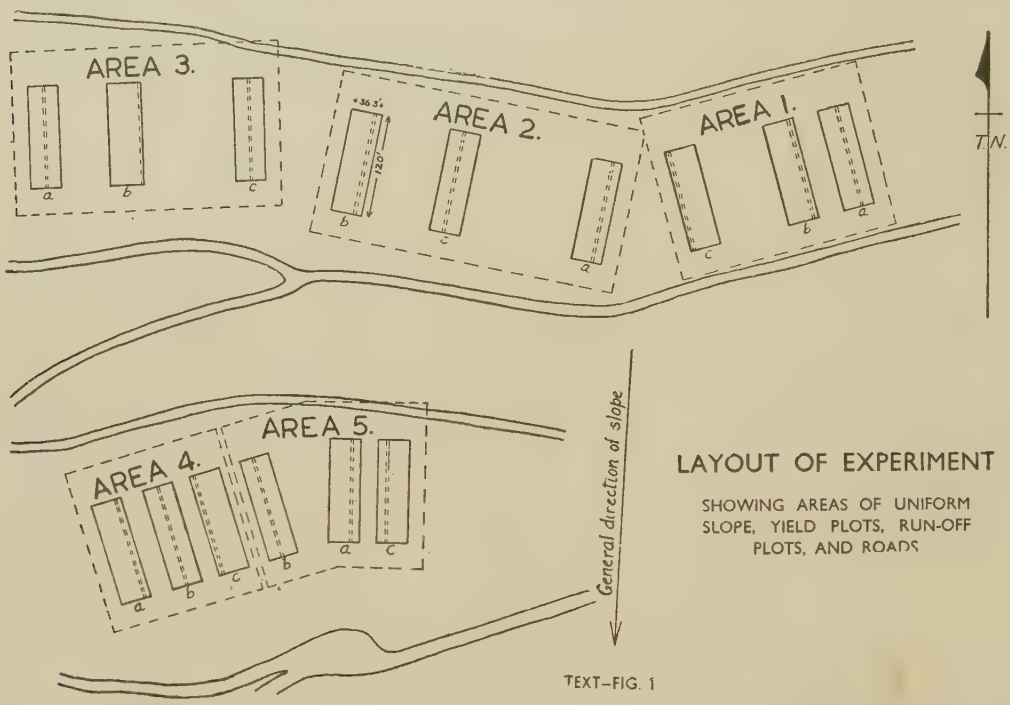
(1) 4° 10′ to 5° 5′, (2) 5° 45′ to 6° 5′, (3) 5° 50′ to 6° 20′, (4) 13° 35′ to 15° 15′, (5) 15° 25′ to 16° 45′.

The tabulated data were then studied to determine the number of run-off plots with identical angles of slope into which each area could be sub-divided, and the approximate width permissible for the surrounding yield plots.

This examination showed that only one replication of the three proposed treatments could be obtained on two of the areas and that on the other three it was not possible to lay out even one complete set of treatments with identical angles of slope.

In view of this finding, attempts were made to locate a more suitable site, but none could be found which fulfilled as many of the basic requirements as the one described above. It was therefore decided to utilize this site, with a full realization of its limitations, and to overcome the lack of replication within areas of uniform slope by treating areas of similar slope as replications and using a split-plot layout. The angles of slope finally chosen for the various plots and the method of grouping, together with data from the previous crop indicating the degree of site uniformity, are shown in Table I, while the layout of the experiment is illustrated in Text-fig. 1. Area 1

was not large enough to provide six plots, and although an area of comparable slope was located nearby, this proved to have soil of a different type. Run-off plots were,



LAYOUT OF EXPERIMENT

SHOWING AREAS OF UNIFORM SLOPE, YIELD PLOTS, RUN-OFF PLOTS, AND ROADS

TEXT–FIG. 1

however, laid down in area 1 to provide data from a gentle slope for comparison with those from the remaining areas, and their angles of slope are included in the table.

TABLE I

Angles of slope, data from the previous crop, and grouping of the areas.

Block	Area	Treatment	Angle of slope of run-off plot	Data from previous crop	
				Mean D.B.H. in inches	Stocking per acre
I	2	a	5° 45′	4·6	488
		b	5° 50′	4·6	452
		c	5° 45′	4·8	376
	5	a	15° 50′	4·7	470
		b	15° 50′	4·3	480
		c	16° 00′	4·8	430
II	3	a	5° 50′	4·7	536
		b	5° 50′	4·6	564
		c	5° 50′	4·2	468
	4	a	13° 55′	4·5	560
		b	13° 55′	4·6	564
		c	14° 05′	4·3	500
	1	a	4° 15′	4·0	620
		b	4° 15′	4·1	650
		c	4° 15′	4·4	448

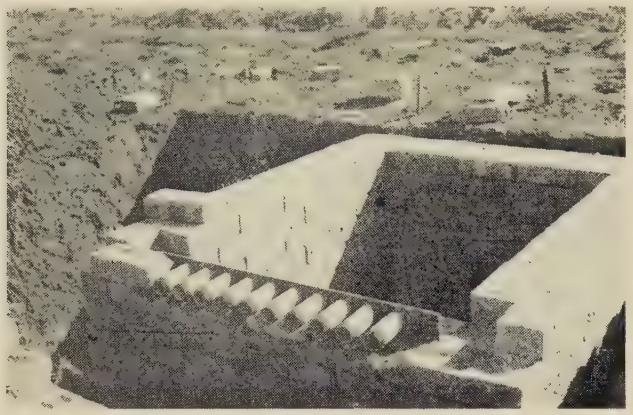


Fig. 1—First tank under construction showing brickwork bond and method of building in overflow plate.

Fig. 2—First and second tanks completed, with division- and baffle-plates in position.

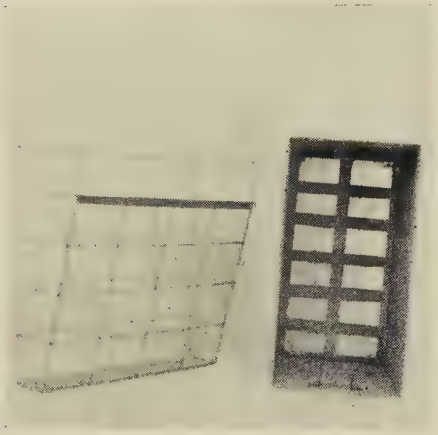


Fig. 3—Litter trap and silt tray.

Fig. 4—Portion of a run-off plot showing metal plot-surround and brick protection.

Fig. 5—General view of areas 4 and 5.

Fig. 6—Method of installing the metal spillway.

While it is unfortunate that the three run-off plots in areas 2, 4, and 5 could not be laid down on ground with identical angles of slope in each case, it was felt that the discrepancies in all cases were so small as to be unlikely to introduce a serious error into the run-off readings. As an additional check on comparability, an examination of plotted slope profiles in each of the areas revealed no important differences between plots.

Since yield plot widths of only 14 yards could be accommodated in areas 4 and 5, and a plot length of 40 yards in the direction of slope was available for all run-off and yield plots, widths of 1·21 yards for the former and 12·1 yards for the latter were adopted throughout to give areas of 0·01 and 0·1 acres respectively. Plate I, fig. 5, shows the layout of plots on areas 4 and 5.

A soil survey, carried out after the plots had been demarcated, showed that the soil over the whole area of the experiment was remarkably uniform in type. The soil was derived from shales of the Lower Ecca Series and was therefore representative of that found over a large proportion of the wattle growing area in Natal. Only at one end of area 1 was there any deviation from this soil type. Here, a doleritic intrusion had occurred and a bright red soil, derived presumably from the dolerite, was found underlying a layer of hard blue shale at a depth of 15 to 24 inches from the surface. This change in sub-soil type affected only part of one plot in area 1 and, as the surface soil was apparently unaffected, was not regarded as likely to affect a general comparison of run-off from this area with those in the main experiment.

The average depth of the surface soil, a dark brown friable loam, ranged from 7 to 11 inches, but showed less than this degree of variation in depth within each series of treatments. The mechanical analysis, carried out by Bouyoucos' hydrometer method, also showed good uniformity over the area of the experiment and gave the following average percentages :

Clay, 59·0 ; Silt, 26·0 ; Fine sand, 15·6 ; Coarse sand, 3·9

The brushwood resulting from the previous crop on this site had been stacked at intervals of from 15 to 20 yards, in piles running up and down the slope, and had all been burnt prior to the regeneration of the stand. The crop on the ground at the time this experiment was begun had been allowed to remain in a very dense condition until the trees were about 15 feet high and had then been rather heavily thinned. The considerable mass of organic material spread over the ground as a result of this thinning had largely rotted down. Thus there was a fair layer of surface litter over the whole area when the crop was felled just prior to the beginning of the experiment.

Apparatus for Measuring Run-off and Soil-loss.

In order to cover a maximum probable volume of run-off, two tanks in series, with a combined capacity equivalent to a run-off of six inches per acre, were used on each plot.

The capacity of the first was equivalent to one inch of run-off per acre, which was thought to be adequate for all but the heaviest probable precipitations. This tank was divided into two compartments by a division-plate and was provided with a baffle-plate and a perforated overflow-plate by means of which excess run-off could be diverted to the second tank. This was designed to hold one-tenth of the overflow from the first tank, and therefore needed to have only one-half instead of five times the capacity of the latter. The method of construction of the tanks is described below and illustrated in Text-fig. 2 and Pl. I, figs. 1–3.

To ensure durability, having regard to the long-term nature of the experiment, the tanks were built in brick laid in cement mortar. An excavation of suitable depth was made just below the lower boundary of each run-off plot and concrete foundations twelve inches wide and six inches deep were cast for each tank. On these foundations, the tank walls were built in nine inch brickwork, the bond normally used for sewer manholes being employed, and cement mortar was grouted between the vertical courses to make the walls as watertight as possible.

When the walls had been built to a height of about a foot, the floors of the tanks were cast in concrete three inches thick, reinforced with heavy wire netting. These floors overlapped the inner edge of the foundations but did not extend to the brickwork, a gap about three-quarters of an inch wide being left to be filled with bitumen as a seal. Waste-pipes and copper guage-pipes had been set in the foundation at the correct level and were now built into the floors of the tanks; at the same time, a groove for the division plate was made in the floor of the first tank.

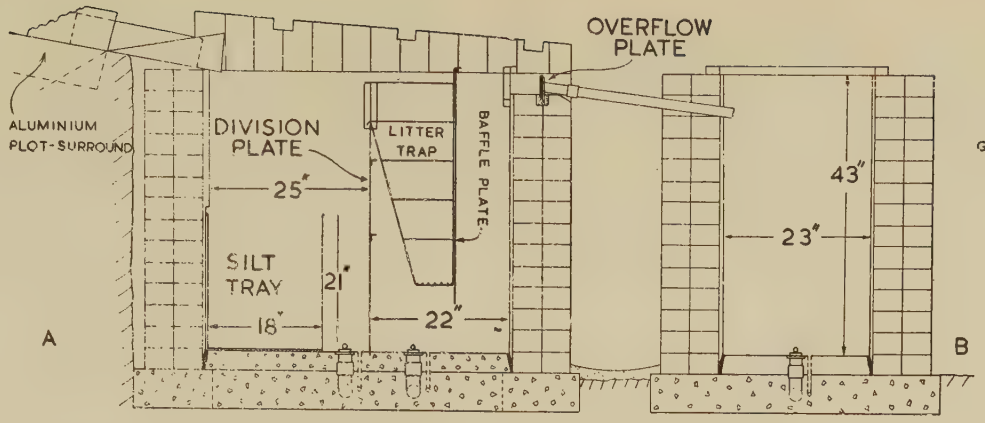
The walls were now taken up to the level of the overflow-plate in the first tank and this plate was built into the wall opposite the side where run-off water would enter. (Pl. I, fig. 1.) It was set in cement, with provision for a bitumen joint between it and the masonry on its inner side. It consisted of $\frac{1}{4}$-inch steel plate four inches wide and three feet long, through which were drilled ten holes, each exactly one inch in diameter and with centres three inches apart all exactly equidistant from one straight edge of the plate In building the plate into the wall of the tank, great care was taken to ensure that its straight upper edge was truly level, so that the ten holes were all at the same level and would allow equal amounts of water to pass through them when the tank overflowed. On the outer side of the plate, a short length of $1\frac{1}{2}$-inch galvanized iron piping, threaded at its free end, was welded over each hole at a slight angle to the horizontal to carry overflow clear of the tank side. Overflow pipes larger than the holes in the plate were used to reduce the chances of unequal pressures being set up as a result of differential friction in the pipes. Owing to the increase in the size of bore, there would be a reduction in pressure immediately the flow passed through the plate, even if the holes were covered by water, and differential friction would be limited to a length of flow equal to the thickness of the plate. Since the plate was only one-quarter of an inch thick and the holes were all identically drilled, it was thought that differences in flow between different holes would be negligible. In order to compensate for possible differences, however, the extension pipe was to be screwed to a different overflow pipe after each rain causing overflow.

The walls were now completed and the division-plate was set in the groove provided in the floor of the first tank ; the walls were then plastered so that the plate was built into the plaster along its vertical sides. At the same time, grooves were made in the plaster so that the baffle-plate could be slid into position and removed when it was necessary to clean the second compartment. Both baffle- and division-plates were of $\frac{1}{16}$-inch mild steel and the latter was reinforced by two lengths of one-inch angle iron welded horizontally across it about one foot apart. After the plastering had been completed, all plaster surfaces were painted with several coats of a commercial water-proofing compound, having a sodium silicate base, to prevent leaks and reduce absorption of water by the plaster. Plate I, fig. 2 shows the tanks at this stage with baffle- and division-plates in position in the first tank.

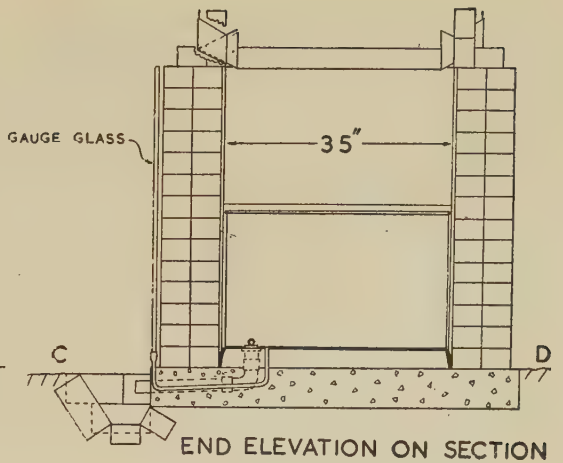
As it was intended to use graduated gauge-glasses to facilitate reading the volumes of run-off water in the tanks, the division-plate was introduced into the first tank primarily to cut off a compartment which would hold run-off from small amounts of precipitation. The gauge-glass in this compartment could then have widely-spaced graduations because of the reduced floor area.

To prevent litter from floating freely into the second compartment, where it might block some or all of the holes in the overflow-plate, a litter trap lined with bronze gauze of 2 mm. mesh (Pl. I, fig. 3) was fitted to the division-plate. Any fine material passing this screen was collected by means of a second gauze screen of 0·2 mm. mesh covering the outlet from the second compartment.

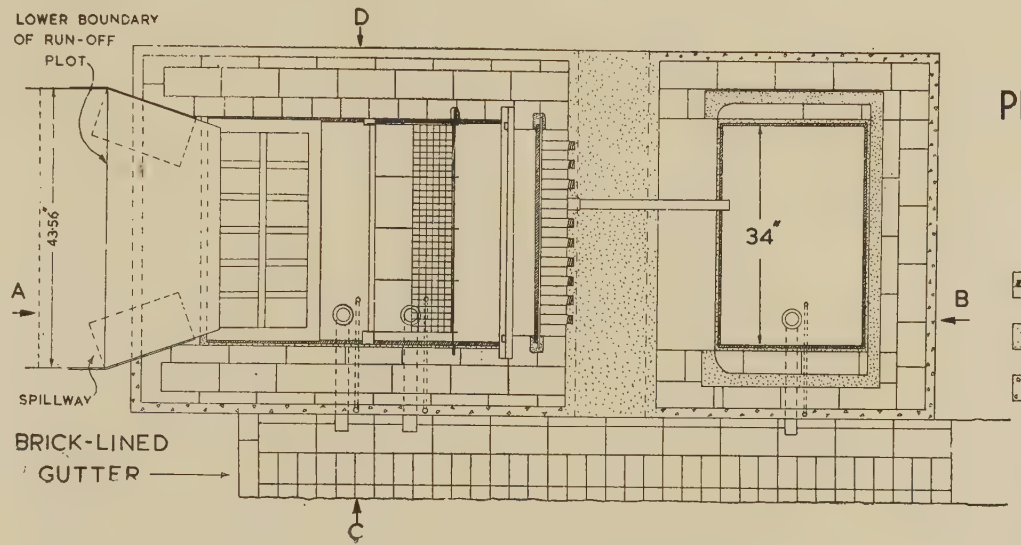
The baffle-plate, which was supported on lugs resting on the side walls of the second compartment and reached to within six inches of its floor, was introduced to prevent surge, due to rapid flow of water over the division plate, causing unequal amounts of water to pass through the various holes in the overflow plate.



SIDE ELEVATION ON SECTION A-B BELOW



END ELEVATION ON SECTION C-D BELOW



PLANS OF RUN-OFF TANKS

SHOWING STRUCTURAL DETAILS

LEGEND

- BITUMEN JOINT
- CEMENT WORK OR PLASTER
- CONCRETE

TEXT-FIG. 2

The $\frac{1}{2}$-inch copper gauge-pipes had been expanded at their outer ends and glass boiler-tubing of approximately the same diameter was fitted into these and the joint sealed with bitumen. These gauge-glasses were then supported in wooden frames fastened to copper wire loops which had been built into the brickwork of the tank walls.

Finally, the first compartment was supplied with a silt tray made of heavy-gauge galvanized iron, its bottom being covered with bronze gauze of 0·2 mm. mesh, supported on a lattice of iron straps (Pl. I, fig. 3.). This was made to fit across the full width of the first compartment, under the spillway, and the plaster of the end wall was recessed, so that any soil carried by water flowing back under the lip of the spillway and down the tank wall would be caught in the trap. The fine gauze bottom prevented the passage of all but the smallest particles and made it possible to lift the tray and allow most of the water to drain away before removing the soil for drying and weighing.

Sheet metal seemed to be the most suitable material for enclosing the run-off plots and aluminium was chosen because of its resistance to corrosion. A barrier six inches high was thought to be adequate to exclude run-off from outside the plot and to accommodate any normal fall of litter during the rotation. It was not known at what rate erosion would occur under the extreme treatment proposed, but it was felt that carrying the metal surrounds to a depth of six inches below ground should be sufficient to ensure that they did not become undercut during the first rotation. Accordingly, 30-gauge sheet aluminium, twelve inches in width, was used to enclose the run-off plots, care being taken to disturb the soil within them as little as possible. Where minor folds in the ground occurred, it was necessary to make small creases in the sheet while laying it, in order to keep the upper edge parallel with the soil surface.

In order to protect the above-ground portion of the metal strip from damage during weeding and thinning operations, two courses of bricks were laid, without mortar, close against the outer side of the strip, a little loose earth being packed below the bottom course to bring the surface of the upper course above the edge of the strip (Pl. I, fig. 4). A space was cleared through the brushpiles in plots occupied by the partial burning and non-burning treatments to allow the aluminium sheet to be placed in position. After this had been done and the metal plots surrounds had been supported by bricks, the brushwood was replaced across the run-off plot, care being taken to use short lengths within the plot so that the brushwood was in contact with the soil surface as in an undisturbed brushpile.

Since the number and size of stumps occurring within the enclosed areas differed from one plot to another, all stumps on the plots were sawn off as close to ground level as possible. This avoided any possible differential effect resulting from a greater degree of obstruction to run-off and soil-loss in one plot than in another.

At the lower end of each run-off plot, a metal spillway was fitted to guide run-off water into the gauging tank. In order to ensure that no run-off escaped under this spillway, its upper edge was buried below the soil surface at the foot of the run-off plot. This was done by marking the lower boundary of the plot with cord and cutting carefully into the soil along this line at an angle of about 30° to the soil surface and to a distance of 12 inches above the lower plot boundary, removing the soil carefully to expose a smooth sloping surface across the full width of the plot. The spillways were made from 24-gauge aluminium sheet, 30 inches wide, by cutting lengths of 43·56 inches (1·21 yards) which exactly fitted between the metal sides of the run-off plots. Each spillway was shaped by first bending the sheet downwards on a line 12 inches from its longer edge, and then bending up the sides of the remaining 18-inch width to make side walls to the actual spillway surface. The line of the first bend was placed carefully along the lower plot boundary and the 12-inch wide bent portion pressed down firmly on the smooth sloping surface described above (Pl. I, fig. 6). The excavated soil was then replaced on top of the metal sheet and gently tamped down until level with the surface of the surrounding soil.

When the spillway had been placed in position, covers were fitted to the tanks to exclude direct precipitation. These were made of a light wooden framework covered with sheet aluminium which projected beyond the framework on the first tank so as to cover the spillway up to the lower boundary of the plot. The covers were held down by hooks fastened to wire loops built into the walls of the tanks and a single course of brick, trimmed suitably to fit, was laid on top of the tank walls to prevent driven rain from entering the tanks under the edges of the covers.

The final step was to calibrate the tanks, and this was done by pouring water, a gallon at a time, into each compartment and marking the level of the water on the appropriate gauge-glass. The first gauge gave readings for the first compartment up to the top of the division plate, the second for the remainder of the first tank, and the third for the second tank, all gallon graduation intervals being divided into four equal parts. Since the run-off plot was 0·01 acre in extent, each gallon in the first tank represented a run-off of 100 gallons per acre, but a similar volume in the second tank was equivalent to a run-off of 1,000 gallons per acre. Thus a volume of run-off in the first tank up to the equivalent of 24,000 gallons per acre could be measured to the nearest 25 gallons per acre, but amounts in excess of this, up to the total capacity of the two tanks, viz., the equivalent of 136,000 gallons per acre, could be measured only to the nearest 250 gallons per acre.

The run-off plots were enclosed and the tanks built during the winter, which is the driest season of the year. During this period, very little rain fell and there were no showers heavy enough to cause run-off. Thus neither soil nor litter was lost from any of the plots before the apparatus described above was completed, and records of run-off and soil-loss began with the first heavy rains of the 1952–53 rainy season.

Acknowledgements.

Acknowledgements are due to Dr. W. S. Martin, of the Wattle Research Institute, who carried out the soil survey and mechanical analysis referred to in the text, to Professor J. D. Scott, of the Natal Agricultural Research Institute, who suggested the principle of an overflow plate with equal-sized holes to make possible a reduction in tank size, and to Mr. E. A. Middleton, Natal Provincial Water Engineer, for much useful advice on the waterproofing of the tanks.

REFERENCES

Craib, I. J. (1934]. Points on wattle production. *S.Afr.Dept.For. Bull.* No. 28.

Craib, I. J. (1935). The wattle industry in South Africa. *Br.Emp.For.Conf., South Africa, 1935.*

Sim, T. R. (1904). The black wattle industry. *Natal Agric. J.*, **7**, 24–25.

Sim, T. R. (1917). The black wattle industry—*Acacia mollissima* Willd., (*Acacia decurrens* Willd. *var. mollis* Benth.) *S. Afr. J.Sci.*,**13**, 279–301.

A RAPID METHOD OF DETERMINING THE RELATIVE TANNIN CONTENT OF YOUNG, LIVING BLACK WATTLE TREES IN GENETICAL AND BREEDING EXPERIMENTS

By C. G. GORDON-GRAY

A suitable method of sampling living black wattle trees of three years of age, without materially damaging them, has been developed. A modified analytical procedure has been devised whereby the relative tannin content of these small samples can be determined, thus enabling trees in genetical and breeding experiments to be placed in order of merit in this respect.

Introduction.

The Official Method of tannin estimation is a long and tedious one and, having been evolved primarily in relation to commercial tanning products, is somewhat prodigal of material. In genetical and breeding experiments, where tannin content is an important factor in selection, it would be of considerable advantage if a reliable method of analysis could be developed, capable of dealing quickly with a large number of small samples from young, living trees.

An estimation of the true tannin content is unnecessary in such experiments ; it is enough that analytical results indicate a relative order of tannin content, bearing a constant relationship to the actual tannin content of the trees.

The Official Method of tannin analysis of bark, based as it is on the interaction of tannin and hide protein, the chemical constitution of each of which is unknown, is purely empirical. Accuracy is the chief essential of the method, while speed of analysis is scarcely a consideration.

Where, however, relative figures and not the true tannin content of bark samples are required, and where a large number of samples has to be dealt with in a limited time it is permissible to modify the Official Method, sacrificing some degree of accuracy for speed.

Nevertheless, in the deveolpment of such a modified analytical method, every departure from the Official Method must be checked carefully by comparison with the latter in order to obtain, within narrow limits, parallel sets of results.

The sampling method must be such that the bark samples will be representative of all the bark on a tree, yet small enough to ensure no danger of serious damage. In addition, the samples must be easily and quickly obtained, so that large numbers of trees may be dealt with in a limited time.

The Analytical Method.

The following changes in the Official Method were introduced :

1. *The Extraction Process.*

Since the relative and not the actual tannin content of trees was required, cold water extraction of bark samples appeared suitable for the following reasons :

(*a*) Large numbers of bark samples could be analysed daily.

(*b*) The volume of water for extraction could be reduced in accordance with the sample weight without introducing undue error, as the tannin was extracted from the bark by the digest water.

The cold water extraction of bark samples was examined by treating nine duplicate samples with cold water at 20-30° C. These samples, 10 to 12 g. in weight, were soaked overnight in 200 ml. of distilled water in a Procter extractor. The following morning, the digest water was siphoned off completely and the sample washed with a further 800 ml. of cold distilled water in successive amounts of 200 ml., each one of which was siphoned off completely before the next was added. The solution was made up to one litre and analysed by the Official Method. The duplicate results agreed within 0·6 per cent.

To test the agreement between the standard Proctor extraction and cold water extraction, a further 47 air-dried bark samples were extracted by each method. The differences in tannin content between the two ranged from 5·8 to 8·6 per cent. with an average difference of 7·3 per cent. The correlation between the results obtained by the two methods was very high ($r = 0{\cdot}983$, d.f. 45).

2. *The Estimation of Tannin.*

(*a*) The determination of total solids was omitted as unnecessary.

(*b*) Due to the smallness of samples, with consequent reduction in volume of the extract solution, the 250 ml. of solution with which the Berkefeld candles were normally washed had to be reduced. This modification was employed despite the fact that possible errors were introduced.

(*c*) Residues were dried by placing in desiccators for 30 minutes directly on removal from the water bath, not less than half an hour after the contents of the last basin had been evaporated to dryness. In the Official Method, residues are heated for three hours in an oven and cooled. The adoption of this modification was justified, since an experimental comparison of the two methods had shown the maximum difference between them to be 0·3 per cent. in tannin.

The Sampling Method.

The usual method of sampling trees by removing large rings of bark could obviously not be followed, so a different method had to be devised.

In order to test new sampling methods, 24 trees of varying ages were felled so that the relationship between the tannin content of the total bark and of the various samples taken could be determined. The basal four inches of bark were discarded and the remainder marked off in feet to the height where the stem became one inch in diameter. The bark above this point was neglected.

As it was necessary to compare a number of different sets of samples from the same tree in order to determine the smallest representative sample, the following samples were taken at specified distances from the base :

(1) *No.* 12 *cork borer.*

- (*a*) 1 pellet at intervals of one foot.
- (*b*) 2 pellets at intervals of one foot.
- (*c*) 2 pellets at intervals of eighteen inches.
- (*d*) 2 pellets at intervals of three feet.

(2) *No.* 6 *cork borer.*

- (*e*) 2 pellets at intervals of one foot.
- (*g*) 3 pellets at intervals of eighteen inches.
- (*h*) 3 pellets at intervals of three feet.

After the cork-borer samples had been taken, each tree was stripped, the whole of the bark oven-dried and pulverised, and a sample extracted and analysed by the Official Method.

The cork-borer samples were dried in an air oven, ground in a coffee grinder, and analysed by the modified method. The volume of digest water and total extract solution was decided by the sample weight as follows :

Sample	*Digest water*	*Total extract*
8 to 12g.	200 ml.	1 litre
4 to 8g.	150 ml.	500 ml.
Up to 4g.	100 ml.	300 ml.

For total extract solutions of 1 litre, 200 ml. quantities of distilled water were used in the washing process, while for solutions of 500 ml. and 300 ml., 100 ml. and 50 ml., quantities respectively were used.

The moisture determination on all samples was done in a special oven in order to obtain the accurate values necessary to calculate results on a moisture-free basis.

The results of these analyses are given in Table I.

TABLE I.

The tannin content of total bark (Official and modified analysis) and cork-borer samples (modified analysis).

Age of tree in years	Average bark thickness in mm.	Percentage tannin, Procter extraction	Percentage tannin, cold water extraction							
		Total bark (A)	Total bark (B)	One No. 12 pellet at intervals of 1 ft. (C)	Two No. 12 pellets at intervals of 1 ft. (D)	Two No. 12 pellets at intervals of 1½ ft. (E)	Two No. 12 pellets at intervals of 3 ft. (F)	Two No. 6 pellets at intervals of 1 ft. (G)	Three No. 6 pellets at intervals of 1½ ft. (H)	Three No. 6 pellets at intervals of 3 ft. (I)
4	36	41·0	30·5	31·8	31·0	32·0	32·7	32·1	31·9	31·3
10	68	39·9	29·5	30·8	31·4	30·4	—	29·2	29·2	29·5
10	38	38·9	27·9	26·4	26·7	27·4	28·7	27·3	28·1	26·6
3	21	38·6	28·9	28·6	29·1	28·4	27·4	28·3	28·2	28·0
3	35	38·4	26·9	29·3	27·1	27·9	31·2	29·6	30·3	28·4
3	39	38·0	27·0	25·6	26·7	25·7	26·5	26·4	27·4	27·7
6	41	37·9	26·9	27·1	26·1	26·4	28·2	27·1	26·9	28·6
6	46	37·4	27·2	27·9	27·6	27·9	29·4	28·0	29·2	28·6
2	25	36·4	23·8	23·4	23·8	23·5	23·8	24·4	23·4	24·5
4	32	35·7	23·2	28·9	28·6	26·9	26·8	24·2	25·0	25·9
4	27	35·3	25·4	23·2	23·8	26·7	25·8	25·0	22·8	23·7
3	25	34·2	23·0	25·5	27·6	25·9	24·6	22·5	24·8	21·2
10	41	33·9	24·5	24·3	21·2	23·7	22·7	24·0	22·2	23·3
10	25	33·8	—	25·0	24·7	24·8	25·1	24·8	—	24·9
3	30	32·3	23·4	22·9	24·0	24·4	24·5	24·4	25·3	22·9
6	30	31·6	20·2	26·3	—	28·1	25·2	24·3	24·4	24·2
3	21	31·3	23·2	23·2	24·6	23·7	22·8	21·1	22·6	23·2
10	28	30·5	19·0	21·0	20·9	20·2	23·0	21·1	19·6	—
2	18	29·1	17·1	17·1	16·9	16·8	18·0	16·1	16·3	14·7
2	17	28·1	16·7	16·5	16·3	16·6	15·6	14·2	16·8	17·2
2	19	27·3	14·7	16·4	18·2	17·4	17·5	16·2	17·4	16·4
2	17	26·6	13·7	17·1	16·4	14·9	15·5	15·1	15·3	12·2
6	21	25·7	15·5	18·2	18·4	18·2	18·6	16·8	16·7	18·9
2	27	24·3	14·2	17·2	18·6	17·9	16·0	15·9	16·5	16·8

Correlation Coefficients :

A & C, $r = 0{\cdot}917$ A & F, $r = 0{\cdot}936$
A & D, $r = 0{\cdot}906$ A & G, $r = 0{\cdot}948$
A & E, $r = 0{\cdot}902$ A & H, $r = 0{\cdot}946$
A & I, $r = 0{\cdot}922$

The weights of samples analysed ranged from 0·5 g. to 12 g.

These results show that both the analytical and sampling methods were satisfactory. Further, all methods of sampling by cork-borer give comparable results, indicating that any one of these would give the relative tannin content of trees, enabling those of highest tannin content to be selected. Since, however, of the procedures giving the highest correlation coefficients, two No. 6 pellets at intervals of a foot caused the least damage, this method of sampling was provisionally adopted.

The extraction of samples of approximately 1 g. weight with 300 ml. of water gave solutions which were too dilute for accurate determinations by the Official Method, and solutions of less than 300 ml. could not be employed, due to there being insufficient solution for correct filtration. This fact may offer the explanation for some inconsistent results.

The first comparison between Procter and cold water extractions revealed a range of difference of 5·8 to 8·6 per cent., whereas with the later samples (Table II) the range was 8·1 to 13·6 per cent. It seemed possible that the explanation of this variation lay in the fact that the former samples were air dried, whereas the latter were oven dried.

To test this, three samples, each consisting of a nine-inch collar of bark, were chopped separately and each sample divided into two. In each case, one half was air dried while the other was oven dried. The oven-dried and air-dried samples were extracted by both Procter and cold water methods and the tannin determined by the Official Method. The results are shown in Table II.

TABLE II.

Percentage tannin determined by Procter and cold water extraction of oven-and air-dried bark samples.

Sample No.	Oven-dried bark			Air-dried bark		
	Procter	Cold water	Difference	Procter	Cold water	Difference
3	38·3	28·0	10·3	38·8	31·9	6·9
4	42·5	31·2	11·3	42·1	35·1	7·0
5	39·0	28·2	10·8	41·3	33·6	7·7

The results show clearly that the amount of tannin extracted by cold water depends on the method of drying the sample, whereas the Procter extraction is virtually unaffected by the method of drying.

The Spectrophotometric Method of Tannin Determination.

At this stage, the proposed method appeared to be satisfactory, but further experience revealed a need to reduce even further the time per tree spent on analysis, as well as the amount of damage done by sampling.

Before proceeding further in this direction, however, the possibility of applying Roux's (1951) proposed spectrophotometric method of tannin determination was examined. Earlier comparisons of this with the Official Method, using conventional samples, had shown that although a difference, characteristic of individual trees, did exist between the two methods, it was small (usually less than 3 per cent.) for black wattle trees. This indicated that the spectrophotometer might be employed, provided it gave satisfactory results in conjunction with cold water extraction.

Accordingly sixteen trees were sampled by the two-pellets-per-foot method. These samples were extracted by the cold water method and the solutions analysed spectrophotometrically. The total bark of each tree was oven dried and a sample extracted and analysed by the Official Method. The results are shown in Table III.

TABLE III.

Tannin content of total bark (Official Method) and of two-pellet samples (spectrophotometric method).

Age of tree in years	Total bark, Offical Method	Two-pellet sample, cold extraction, spectrophotometric determination	
	Percentage tannin	Wt. in g.	Percentage tannin
3	37·0	1·6661	27·7
4	36·0	3·4405	27·4
3	35·7	0·8726	24·2
4	35·3	2·2916	25·0
3	34·7	1·5867	27·2
4	34·3	2·7984	25·4
4	33·9	2·4807	20·7
4	33·8	2·6585	20·4
3	32·9	1·7965	21·4
3	31·9	1·0505	15·3
3	29·1	1·7473	22·2
4	28·4	1·2970	13·5
3	28·2	1·5536	21·1
4	28·2	2·1679	18·6
3	27·9	1·5617	18·6
3	27·3	1·0382	18·2

Correlation Coefficient : $r = 0{\cdot}751$

The reduced correlation obtained may possibly be due to the extraction of small samples in the Procter extractor and to the fact that the hide powder and spectrophotometric methods do not give identical tannin percentages even for the same extract solution. However, the correlation coefficient, which is highly significant ($P < 0{\cdot}001$), shows this method of tannin estimation to be suitable. Consequently the desired reduction in sample size became feasible.

The comparison of sampling methods (Table I) revealed that one No. 12 cork-borer sample per foot was satisfactory and it appeared not unlikely that one No 6 pellet might also be adequate. This possibility was now investigated. Further, due to the difficulty and waste of time in sampling to the tops of trees, it was decided to compare two No. 6 cork-borer samples, one from the basal eight feet, the other from the basal 12 feet of trees three years of age.

The extraction apparatus was modified to deal with the extremely small samples (1 g. or less), which were the result of single pellet sampling to the reduced height. The extractor consisted of a short-stemmed thistle funnel, with pressure tubing and screw clip attached. A piece of cloth gauze was fitted into the bulb of the funnel and on to this was poured a layer of sand. The volume of digest and wash water was fixed at 25 ml., regardless of sample weight, and the total volume of extract solution at 100 ml.

The combined modifications were now tested on twenty trees three years of age. Again, the tannin content of the total bark was determined by the Official Method. The results are shown in Table IV.

TABLE IV.

Tannin content of total bark (Official Method) and of single-pellet samples (spectrophotometric method) from eight feet and from twelve feet.

Total bark, Official Method Percentage tannin (A)	One No. 6 pellet drawn from each foot of bark			
	Basal 8 ft.		Basal 12 ft.	
	Bark weight in g.	Percentage tannin (B)	Bark weight in g.	Percentage tannin (C)
37·3	0·7338	28·2	0·9888	25·5
34·7	0·7515	21·3	1·0748	22·0
34·1	0·5495	25·2	0·7592	23·2
33·1	0·6718	26·0	0·7990	23·8
32·7	0·7932	26·1	0·9836	22·6
32·2	0·7049	23·0	0·9484	23·2
31·7	0·5945	23·4	0·8403	21·5
29·8	0·6280	24·4	0·8479	20·9
29·1	0·5696	21·0	0·8132	20·1
27·4	0·7489	21·9	0·9485	19·1
26·9	0·4208	19·4	0·5762	15·6
26·7	0·4358	21·6	0·5759	18·5
26·4	0·4783	21·1	0·6189	18·9
26·3	0·6012	19·4	0·7935	16·4
26·2	0·6744	19·4	0·9578	18·0
25·9	0·5331	19·4	0·7787	17·4
25·8	0·5438	18·1	0·7276	16·5
25·4	0·5430	20·8	0·6741	16·7
18·7	0·4526	15·3	0·5809	14·0
17·2	0·4399	19·5	0·6502	13·7

Correlation Coefficients: A & B, $r = 0{\cdot}827$; A & C, $r = 0{\cdot}945$

Since more consistent results were obtained from samples taken from the basal 12 feet, this was made the standard height for sampling in all subsequent work with three-year-old trees.

Conclusion.

The important points emerging from this investigation are as follows :

(*a*) Down to the diameter of a No. 6 cork-borer, the pellet size is not significant, provided it is constant for each tree and does not involve appreciable damage.

(*b*) The method of drying must be the same for all samples.

(*c*) The cold water method of extraction is quick and satisfactory, but may give rise to appreciable errors if the washing of the samples is not done correctly.

(*d*) For small samples, the spectrophotometric method of tannin estimation is more satisfactory than any modification of the Official Method here examined.

(*e*) For large samples, the Official Method, together with the modification for drying residues, is suitable.

Bearing in mind these and other considerations discussed in the paper, the method finally evolved comprised taking single-pellet samples with a No. 6 cork-borer at intervals of one foot over the basal 12 feet of the tree, extracting with cold water under prescribed conditions, and estimating the tannin spectrophotometrically.

Acknowledgement.

The author wishes to thank Dr. A. A. Moffett for some very helpful suggestions during these investigations.

REFERENCE

D. G. Roux (1951). Photometric methods of tannin analysis for black wattle tannin. *J. Soc. Leather Trades' Chem.*, **35**, 322.

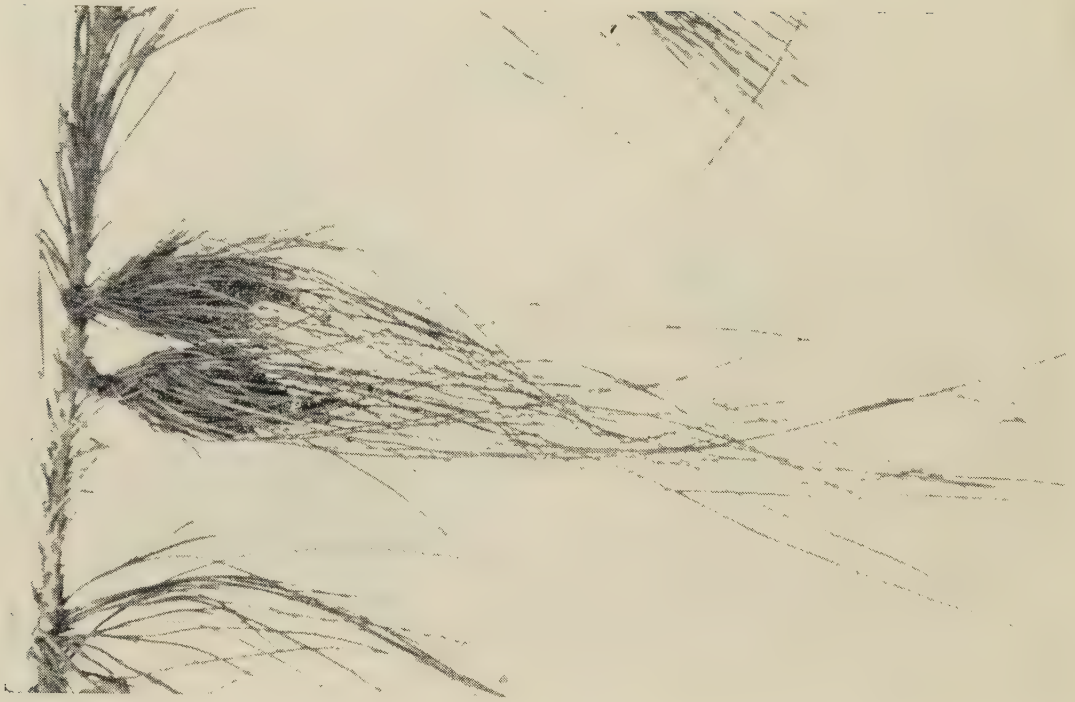


Fig. 2—Bagworms on pines (natural size).

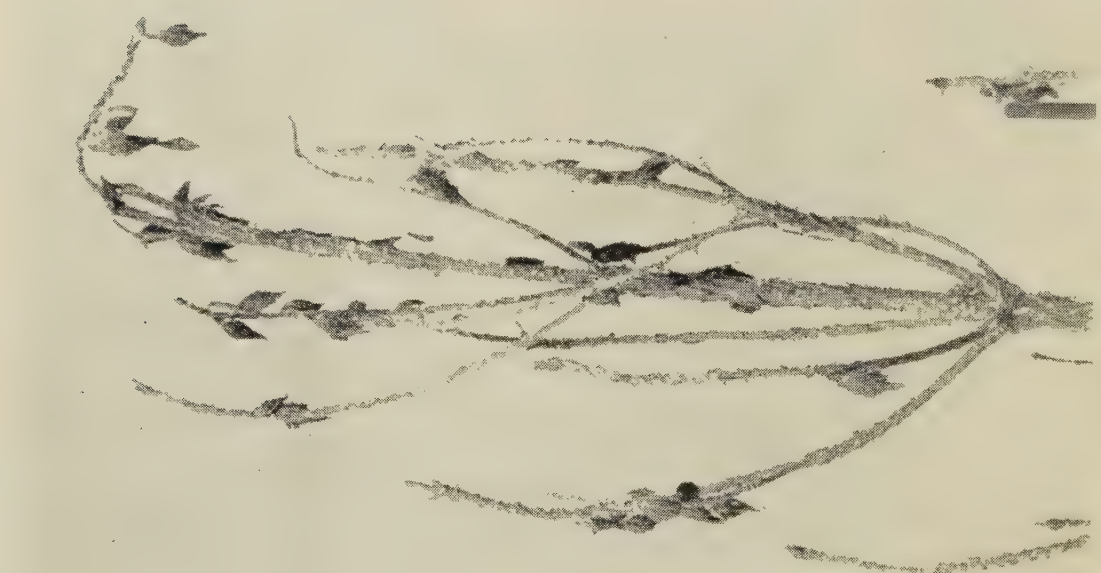


Fig. 1—Top of pine defoliated by bagworm (one-sixth natural size).

NOTES ON INSECTS OBSERVED DURING THE PERIOD 1952-1953

By L. L. J. OSSOWSKI

An account is given of the insects observed damaging wattle plantations during 1952–53 and of the areas affected. Parasites and predators not previously recorded are listed.

The population of some insect species has increased in the year under review, especially that of the wattle bagworm, lasiocampids, and some chafer beetles. Several other insects, hitherto not recorded as potential wattle pests, were observed to have damaged plantations. Four of these species have no common English names and, therefore, popular names are suggested and are denoted by asterisks in the appropriate headings. A number of parasites and predators, not noticed in previous years, were also found and are listed in this paper.

I. ORDER : LEPIDOPTERA

Family : *Psychidae*

1. *Wattle Bagworm*, Acanthopsyche junodi *Heyl.*

The bagworm population increased greatly during the past season and an area of well over 100,000 acres is now infested. Out of this acreage, some 12,000 acres showed complete defoliation. The main centres of infestation are in the Harding, Richmond, Hilton Road, Wartburg, New Hanover, Greytown, Ahrens, Kranskop, and Vryheid districts. In some parts of the last-named area, the peak of infestation was reached during the year and the crisis in parts of the Greytown, Ahrens, and Kranskop districts is to be expected during the coming season. An abatement in the remaining areas will probably take place not earlier than between 1954 and 1956. The bagworm population in Zululand is building up rapidly and defoliation of some 3,000 acres is anticipated in the coming season. In plantations below Natal Table Mountain, the peak was reached last season and the infestation has moved from the lower-lying plantations towards the higher ones, where it has entered the first year of its initial stage. A dangerous centre of infestation is building up some two miles north of Pietermaritzburg. The infested plantation is situated on a prominent hill overlooking some 2,000 acres of wattles which are at present free of bagworms ; it is anticipated that these plantations will become infested in the coming season. Wattles in the Howick area are practically free of bagworms except for a few isolated plantations, where the infestation shows signs of building up. The same is true of the greater part of the wattle growing area in the Transvaal and Swaziland except for some 2,000 acres around Iswepe and Wakkerstroom, where the infestation appears to have entered the second year of its initial stage.

Bagworm infestation was particularly severe around Welgegund in the Ahrens district, where these insects, after defoliating wattles, attacked spreading-leaved pine, *Pinus patula*, surrounding the defoliated wattles. The tops of nearly all pines were defoliated and the trees have so far not recovered (Pl. II, figs. 1 and 2).

The natural mortality of bagworms feeding on pines was very high and only a very small percentage reached the pupal stage. Nearly 24 per cent. were destroyed by parasites.

Mortality caused by *Isaria* was very high in plantations in the Richmond district and west of Ahrens. High mortality due to parasites was observed in plantations where the infestation had reached the last year of its prodromal stage or the eruptive stage. During the year under review, 35,282 bagworms were collected and examined and it was found that 9·2 per cent. were affected by dipterous and hymenopterous parasites. The following table gives details according to months of examination :

Month	No. of			% Bagworms parasitized by		Total affected %
	plantations	trees	bagworms	diptera	hymenoptera	
April	8	66	13,504	3·3	3·7	7·0
May	3	51	11,643	4·7	5·2	9·9
June	2	15	2,554	4·0	5·8	9·8
July	4	26	6,062	3·3	6·3	9·6
August	3	10	1,519	2·9	7·0	9·9
Total	20	168	35,282	3·6	5·6	9·2

In comparison, 7·4 per cent. of 75,060 bagworms examined during 1949–1952 were destroyed by parasites.

The following parasites and predators were found preying on bagworms :

Diptera :

Tachina fasciata Fln.*spp.*

Hymenoptera :

Oneilella sp.nr. *formosa* Brullé, a polyphagous parasite found also on *Gonometa postica* Wlk.

Coleoptera :

Lopholagria villosa Thunb.

The crested hornbill, *Baryrhynchus cristatus brevis*, was observed feeding on bagworm pupae. Full bags were picked from trees, dropped to the ground or carried to a thick, forked branch, and the pupae extracted.

2. *Lictor Bagworm*, Clania moddermanni (*Heyl.*)

A deep infiltration of this species into wattle plantations was observed in the Table Mountain area and at Hill Crest. The invaded plantations form isolated blocks surrounded by thornveld.

Family : *Cossidae*

3. *Crossed-stick Bagworm*, Gymnelema vinctus (*Wlk.*)

These bagworms were found feeding in considerable numbers on older wattle trees at Vumba, near Umtali, Southern Rhodesia.

Family : *Tineidae*

4. *Clear Spiral Bagworm*, Melasina tyrophanes *Meyr.*

The bag of this species consists of small sticks arranged at a slight angle and increasing in length towards the upper part of the bag, which assumes a spiral form. The females, which are attached to the bag, have rudimentary wings and functionary legs and are capable of restricted locomotion only. There seem to be two generations in one year.

This bagworm feeds mainly on grass and wattle undergrowth and has so far not been regarded as a serious wattle pest. Lately, however, it was reported to have damaged young wattles at Rietvlei, near Vryheid.

Family : *Lasiocampidae*

5. *Small Wattle Lappet Moth,* Anadiasia punctifascia *Wlk.*

Outbreaks of this pest were severe during 1952–53, especially in plantations near the coastal belt. In many places, stripping operations had to be stopped due to the abundance of larvae, the hairs of which cause irritation not only to human skin, but also to that of other warm-blooded animals. Horses used for dragging wattle timber in infested plantations were reported to be incapacitated for some time.

Some 4,000 acres were infested in the Port Shepstone—Harding district and out of this, nearly 1,000 acres were completely defoliated. The infestation in the Richmond area, though localized in smaller, scattered blocks, spread throughout the whole district and was the worst experienced in the last five years. In the Eastern Transvaal, the Ermelo district showed an infestation over some 1,000 acres of wattles, which were partially defoliated. An infestation over some 200 acres was reported from Tatafalaza in Zululand. Larvae were also abundant in the Table Mountain district and in plantations around Fawn Leas.

6. *Grey Wattle Lappet Moth,* Pachypasa truncata *Wlk.*

The population of this lasiocampid has increased and serious outbreaks were observed and reported from the Table Mountain, Ahrens, Fawn Leas, and Vryheid districts. Around Fawn Leas, some 150 acres of 2–4 year old wattles were completely defoliated.

Parasites of *Pachypasa* were found and identified as follows :

Diptera:

Sericophoromyia quadrata (Wied.) (on larvae).
a *Sarcophaga* species, undescribed (on pupae).

Hymenoptera :

a *Meteorus* species, probably *sp.n.* (on larvae).
a *Pimpla* species, undescribed.
Pimpla mahalensis Gribodo.
Theronia lurida Tosq.
Troticus rufa Cam.

The last-named four parasites were found on pupae.

7. *Cape Wattle Lappet Moth*,* Pachypasa capensis *Stoll.*

The bionomy of this insect is similar to that of the grey lappet moth. As the name suggests, it is to be found mainly in the Cape Province, though it also occurs in Natal. It was found damaging young plantations around Cedara and World's View, near Pietermaritzburg.

8. *Large Wattle Lappet Moth,* Gonometa postica *Wlk.*

This moth seems to infiltrate plantations from the thornveld and its population in wattles is steadily increasing and damage becomes more widespread. Plantations near Greytown, Albert Falls, Kranskop, and Cedara had serious infestations. In the last-named area, polyhedral wilt, which was prevalent among larvae of the third and fourth instars, was responsible for a decrease of larvae.

Two parasites were found to prey on larvae and pupae, viz. :
Sturmia (*Pimelimyia*) *semitestacea* Villen, a dipteron, and
Oneilella sp.nr. *formosa* Brullé, a polyphagous ichneumonid.

Family : *Saturniidae*

9. *Wattle Emperor Moth,* Gynanisa maja (*Klug*).

Larvae were abundant in young plantations in the Table Mountain district and around Lusikisiki. In the latter area, many larvae died of polyhedral wilt.

10. *Willow Tree Emperor Moth,* Gonimbrasia tyrrhea *Cram.*

Wattle plantations at Cofimvaba and Ibeka in the Transkei were again infested over an area of 640 acres, of which a large percentage was completely defoliated. Damage was particularly severe in plantations from six years of age onwards. Defoliation in younger stands was slight.

Trees growing on slopes and ridges showed a more severe defoliation than those growing in valleys, where the site is better and there is less danger from drought.

11. *Pine Tree Emperor Moth,* Nudaurelia cytherea capensis *Stoll.*

The native food plants of this insect in the Cape Midlands are *Rapanea melanophleos* Aubl. and *Euclea daphnoides* Hiern., but it is also a long-established pest on exotic pines and some eucalypts and started lately to attack black wattle. Plantations at Ngamakwe, Munyu, and Tsojana in the Transkei were invaded and some areas defoliated.

Family : *Noctuidae*

12. *Wattle Noctuid,* Achaea lienardi *Boisd.*

This insect was widespread throughout the lower-lying parts of the wattle belt of the Natal Midlands and Pondoland, particularly in wattles growing near the coast, where some 2,000 acres were invaded and partially defoliated. In the Dalton-Harburg area, more than 1,000 acres of wattles of all ages were defoliated. Severe attacks were also reported from Zululand. In Boegoenek alone, in the Melmoth district, 420 acres of wattles were invaded and on approximately 70 acres, which were completely defoliated, stripping operations had to be discontinued. Around Eston and Mid-Illovo and in the Umlaas Road area, the infestation was very severe. Approximately 1,500 acres were infested and partially defoliated. Around Lusikisiki, plantations over an area of 400 acres suffered from severe attacks and at Hillcrest, 260 acres were invaded and completely defoliated. The infestation in the last-named district was held in check by several predaceous insects, viz., two shield bugs, *Glypsus maestus* Germ., and *Macrorhaphia spurcata* Walk., and a caterpillar-killer burrowing wasp, *Amnophila beniniensis* Pal. Beauv. It was also observed that at Hill Crest, large numbers of noctuid larvae were destroyed by red-winged starlings, *Onychognathus morio morio,* South African kestrels, *Falco tinnunculus,* and yellow-billed kites, *Milvus migrans parasitus.* A dipterous parasite, *Tachina fallax* Meig., was reared from larvae and pupae of the wattle noctuid. Taylor (*in lit.*) mentions finding one dipterous parasite, *Zygobothria inconspicua* Mg., and one predator, *Glypsus conspicuus* Westw., on *A. lienardi.*

Family : *Arctiidae*

13. *Black Woolly Bear,* Diacrisia lutescens *Wlk.*

Larvae of this insect were abundant in young plantations near Pietermaritzburg, where they damaged some 10 acres of young wattles.

Family : *Tortricidae*

14. *Wattle Webworm,* Polychrosis incultana *Wlk.*

Outbreaks of this pest were observed at Hill Crest, where it coincided with an attack of froghopper. Some 100 acres of young wattle trees were invaded and partly defoliated. Plantations near Lusikisiki also suffered from an outbreak.

The green white-eye, *Zosterops virens virens* was seen to tear webworm larvae from their nests.

II. ORDER : COLEOPTERA

Family : *Scarabaeidae*

15. *Large Wattle Chafer Beetle,* Hypopholis sommeri *Burm.*

The large wattle chafer beetle damaged some 2,000 acres of wattle, mainly 2–4 years old. In some instances, trees were completely defoliated and since thin branches also were damaged, tops were broken by wind and crowns became deformed. The outbreak was particularly severe in the Richmond and Hilton Road areas, where over 300 acres of wattles were defoliated. In the New Hanover—Wartburg area, 400 acres were heavily infested and approximately 90 acres completely defoliated. Less severe attacks were reported from the Vryheid and Harding districts.

16. *Small Wattle Chafer Beetle,* Monochelus calcaratus *Burm.*

Outbreaks of this pest were reported from the Ixopo district, where 150 acres of wattle were attacked and partly defoliated. Plantations near Kranskop were also invaded over an area of 50 acres. In the Seven Oaks district, approximately 200 acres were completely defoliated, while at Gowan Brae, near Merrivale, wattles as well as weeping willows, *Salix babylonica* L., were attacked and defoliated.

The fork-tailed drongo, *Bhuchanga adsimilis adsimilis* was observed to visit trees infested with beetles and to destroy them. Also the white-throated swallow, *Hirundo albigularis,* was reported to hunt for these insects.

17. *Mashonaland or Rhodesian Cockchafer,* Eulepida mashona *Arrow.*

The damage done by these beetles to young plantations in Southern Rhodesia is still considerable, though there are indications that the population is decreasing. This is most probably due to the very extensive fogging and spraying campaign conducted from 1951 onwards over several thousands of acres of indigenous bush and to the use of soil insecticides on a large scale. The adults still feed mainly on the foliage of indigenous trees and a deep penetration into wattle plantations in search of food has thus far not been observed.

A dipterous parasite, *Muscina fabulans* Fln. and a predaceous mite, *Caloglyphus berlesi* (Mich.), were found on larvae and pupae.

Family : *Chrysomelidae*

18. *Iridescent Wattle Chrysomelid**, Colasposoma fulgidum *Lef.*

This insect lately invaded wattle plantations in larger numbers, defoliating trees up to one year old. Outbreaks of this pest coincide usually with those of wattle scarabaeids and the combined damage done may be considerable. Infestations were reported from the Ahrens, Pietermaritzburg, and Harburg districts. The area affected amounted to 120 acres.

19. *Green Wattle Chrysomelid**, Colasposoma semihirsutum *Jac.*

The damage done by this species is similar to that by *C. fulgidum ;* the two beetles usually occur together. In 1952–53 there were outbreaks over an area of 90 acres in the Pietermaritzburg and Harburg districts.

Family : *Galerucidae*

20. *Brown-headed Wattle Galerucid**, Monolepta allardi *Wse.*

As far as the writer is aware, this beetle was observed for the first time in 1952 to invade and damage young wattle trees over a large area. Approximately 250 acres of one-year old plantations were invaded in the Melmoth district and nearly 100 acres at Boegoenek were severely damaged. The attack coincided with a moderate froghopper outbreak. The damage is done by chewing the young succulent tips, which wilt and break off.

Family : *Cerambycidae*

21. *Red-Banded Longhorn Beetle,* Pycnopsis brachyptera *Thoms.*

This insect was reported to have damaged wattles around Ahrens and Vryheid, at Barberton, and in the Table Mountain area. Particularly severe damage was observed at Fawn Leas.

III. ORDER : ORTHOPTERA

Family : *Acrididae*

22. *Elegant or Soldier Locust,* Locusta elegans (*Thunb.*).

Damage done by this locust to young wattle trees was reported from plantations around Pietermaritzburg, from the Karkloof area, and from plantations near Vryheid and Port Shepstone. The locust attacked mainly the thinner top parts of the tree, in consequence of which the tops were broken by wind and the crowns deformed.

IV. ORDER : HEMIPTERA

Families : *Jassidae* (*Cicadellidae*) *and Capsidae*

23. *Large Green Jassid,* Bythoscopus cedaranus *Naudé,* and
24. (*Brown*) *Capsid,* Lygidolon laevigatum *Reut.*

These insects, commonly known under the collective name of " froghopper," were abundant last season in wattles and severe damage was observed in or reported from plantations covering an area of some 8,000 acres. The attacks were particularly heavy in Pondoland and in the Mid-Illovo and Seven Oaks districts. In the last-mentioned area, approximately 4,000 acres showed complete defoliation. In Hill Crest, where a froghopper outbreak coincided with that of wattle noctuid and webworm, over 250 acres were attacked by jassids and capsids and 50 acres severely damaged.

It was noticed that plantations which were intercropped with maize or beans were more severely damaged by froghopper than those planted without catch crops.

Green Wattle, *Acacia decurrens* Willd., which hitherto was regarded as being immune to froghopper attack, was damaged this season in plantations in the Albert Falls district.

V. ORDER : THYSANOPTERA

Family : *Thripidae*

25. *Citrus Thrips,* Scirtothrips aurantii *Faure.*

The infestation of green wattle by this thrips, reported for the first time in 1951/52, recurred last season. A smaller area than before, viz. 300–400 acres of two to four year old trees was infested and damaged. Heavy rains which fell in October and November, 1952, seem to have been detrimental to the normal development of these insects. As in the previous season, only green wattles were damaged, though these insects were as abundant on black as on green wattles.

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PUBLICATIONS, 1952-53

Anon. .. .. .. "The Wattle Research Institute Report for 1951-1952 (Fourth-Fifth Years)". *The Wattle Research Institute,* October, 1952.

Moffett, A. A. .. "Differential Germination in the Black Wattle (*Acacia mollissima* Willd.) Caused by Seed Treatment." *Rep. Wattle Res. Inst. for 1951-1952* (1952), 39.

Ossowski, L. L. J. "Notes on Wattle Insects Observed during the Period 1949-1952." *Rep. Wattle Res. Inst. for 1951-1952* (1952), 51.

Metcalf, P. E. and L. L. J. Ossowski "A Comparison of the Size of Droplets in Oil Fogs." *Rep. Wattle Res. Inst. for 1951-1952* (1952), 59.

Sherry, S. P. .. "General Environmental Requirements for Commercial Cultivation of Black Wattle in South Africa." *Rep. Wattle Res. Inst. for 1951-1952* (1952), 64.

Sherry, S. P. .. "The Establishment and Re-Establishment of Wattle Plantations." *Rep. Wattle Res. Inst. for 1951-1952* (1952), 68.

Sherry, S. P. .. "A Revised Valuation of Wattle Plantations for Insurance." *Rep. Wattle Res. Inst. for 1951-1952* (1952), 73.

Copies of the above and of the publications listed on page 13 may be obtained on application to the Institute.

BOOK REVIEWS

Ossowski, L. L. J. "Die Laubgehölze", by G. Krüssmann. *J. S. Afr. For. Ass.*, 1952, **No. 22,** 71.

Ossowski, L. L. J. "Handbuch der Pflanzenkrankheiten. Bd. IV. Erster Teil," edited by H. Blunck. *J. S. Afr. For. Ass.*, 1952, **No. 22,** 75.

THE NATAL WITNESS (PTY) LTD., PIETERMARITZBURG